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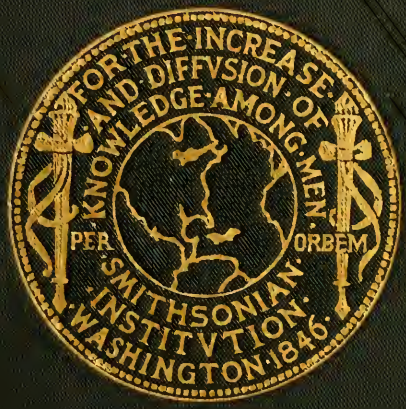

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SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
BULLETIN 165

THE BRYOZOAN FAUNA OF THE VINCENTOWN LIMESAND

BY
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UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1933

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The present work forms No. 165 of the *Bulletin* series.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution

WASHINGTON, D.C., *October 12, 1933.*

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THE BRYOZOAN FAUNA OF THE VINCENTOWN LIMESAND

By Ferdinand Canu [1]
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INTRODUCTION

The Mesozoic rocks of North America have so far afforded few species of Bryozoa, in strange contrast with Europe, where many of the formations, particularly of the Cretaceous system, often literally abound in examples of the two orders Cyclostomata and Cheilostomata. During our studies of the Tertiary Bryozoa of North America, published as United States National Museum Bulletins 106 and 125, we had occasion to investigate the generic types present in the Vincentown limesand, a formation of the coastal plain of New Jersey, at that time placed near the top of the Cretaceous and the only strata in North America of supposed Mesozoic age that contain a considerable number of those organisms. Some layers of the Vincentown limesand are so crowded with fragments of several bryozoan species (pl. 21) that there is little room for other fossils, which, indeed, are rather rare except for the microscopic Foraminifera and Ostracoda. Incrusting these few species (*Coscinopleura digitata* and *Pliophloea sagena*) are many of the forms herein described. Occurring more rarely with them in the loose sands are the other species described.

The Vincentown limesand and associated formations crop out in a belt running diagonally across the State of New Jersey in a northeast–southwest direction from Raritan Bay to Salem County. These formations have been the subject of study by several eminent paleontologists and stratigraphers, and an excellent account of the facts concerning them is given by Weller in his report on the Cretaceous

[1] Dr. Canu died on Feb. 12, 1932, a few weeks before this bulletin was submitted for publication, bringing to a close the association of the authors in scientific work of almost a quarter of a century.—Editor.

of New Jersey.[2] The arrangement of the stratigraphy shown in table 1 was adopted by the United States Geological Survey and was proposed by Knapp and Kümmel.

Weller, after a critical study of the faunas, concluded that two main divisions would more exactly represent the true history of the formations. The close relationship of the faunas led him to place in one group, designated the *Ripleyian*, all strata from the Magothy through the Tinton sand. The higher faunas, including the Hornerstown marl, Vincentown sand, and Manasquan marl, he grouped under the term *Jerseyian*, as their typical development is in New Jersey. Weller recognized the Jerseyian as of Upper Cretaceous age on the basis of the close relationship of the faunas with those of the Maastrichtian division of the Danian series of the Cretaceous of western Europe.

TABLE 1.—*Cretaceous and Eocene formations in the Coastal Plain of New Jersey*

SYSTEM	SERIES	FORMATION	THICKNESS
			Feet
Tertiary	Eocene	Shark River marl	
		(Unconformity.)	
		Manasquan marl	25
		Rancocas group:	
		Vincentown sand	25– 70
		Hornerstown marl	30
		Monmouth group:	
		Redbank sand with Tinton sand	10
		Navesink marl	25– 40
Cretaceous	Upper Cretaceous	Mount Laurel sand	5– 60
		Matawan group:	
		Wenonah sand	20– 35
		Marshalltown formation	30– 35
		Englishtown sand	20–100
		Woodbury clay	50
		Merchantville clay	60
		Magothy formation	25–175
		Raritan formation	150–250

C. Wythe Cooke and Lloyd W. Stephenson[3] focused attention on the question of the age of the Vincentown and associated Upper Cretaceous formations. The abstract of their paper presented briefly the question at issue and the basis upon which the authors reached the conclusion that these formations should be placed in the Tertiary instead of the Upper Cretaceous:

Three formations of the coastal plain of New Jersey, the Hornerstown marl, the Vincentown sand, and the Manasquan marl, which have heretofore been referred to the Upper Cretaceous series, are, on the basis of a new analysis of their contained fauna and the transgressive overlap of the Hornerstown

[2] Weller, Stuart, New Jersey geological survey, vol. 4, 1907.

[3] The Eocene age of the supposed late Upper Cretaceous greensand marls of New Jersey. Journ. Geol., vol. 36, no. 2, pp. 139–149, 1928.

marl on formations of undoubted Upper Cretaceous age, now correlated with the Eocene. The three formations and the overlying Shark River marl, the Eocene age of which has not been questioned, are, on the evidence of common fossil species, correlated approximately with the Pamunkey group (Eocene) of Maryland.

As intimated above, our studies of the Vincentown Bryozoa have been almost entirely from the systematic and biologic standpoints, so that our opinions as to the age of the formation are based solely upon comparisons with the well-known Upper Cretaceous and early Tertiary faunas of Europe. The Vincentown Bryozoa certainly show close similarity to those of the Maastrichtian and Danian divisions of Europe, with various genera and some identical species and little relationship to the usual Tertiary faunas of either Europe or America. It is true that various characteristic species of the Vincentown fauna are present in the Aquia formation in Maryland referred to the base of the Eocene and likewise that the Clayton limestone at the base of the Eocene (Midwayan) in the Gulf Coastal States contains similar genera. It is evident that the much-discussed subject of the Cretaceous–Tertiary boundary line is again in question.

In spite of the abundant material available for study in the preparation of this bulletin, certain biological details of some of the species still remain unknown. The Vincentown limesand is usually composed of unconsolidated sands (pl. 21), so that collecting consists mainly in passing the loose material through a fine sieve and then washing and assorting the myriads of specimens left behind. The Vincentown, N.J., locality has furnished the greater part of our material, but here the specimens are not so well preserved as at Blackwoodstown, a locality now lost, from which a sample was collected for the National Museum over half a century ago. The two Delaware localities are represented by a few but most excellently preserved specimens furnished us by officials of the Maryland Geological Survey. These three localities if rediscovered would undoubtedly yield exquisite material for future studies.

MEASUREMENTS

Micrometric measurements for the determination of species of Bryozoa were inaugurated by Smitt in 1872; they were adopted in general for the Cyclostomata by Pergens in 1889, and for the Cheilostomata by Canu in 1900. At the present time there is scarcely an author who does not consider them indispensable. If not using actual figures, the authors mention the scale of their illustrations. Still another way of evaluation is to establish the number of cells or apertures in a convenient unit. This number is often a specific characteristic, and it adds to the value of the measurements and simplifies the determination.

We have chosen 2 millimeters square (4 square millimeters) as a convenient unit, because this usually permits estimates that are neither too small nor too large. For the giant species the numbers are small, without, however, losing their characteristic value. For species of the Membranipore type, it is necessary to count the cells or at least the opesia, which makes an estimate a little less exact. For species of the Escharian type we count the number of apertures visible in this same space. In general the numbers observed are between 10 and 30. For the small species the number becomes too large and cannot be easily and correctly estimated. For such cases we have chosen another unit, 1 square millimeter, which furnishes a more convenient number ranging between 5 and 15. All the Retepores and many of the Adeonidae can be calculated only by the square millimeter. In the Onychocellidae and all species with large interzooecial avicularia we count the latter as well as the onychocellaria as true cells. In the Celleporidae it is necessary to compute the oriented and the cumulated cells separately.

Thus, the number of cells on a given surface varies according to the size of the cells. For example, this number is larger in the neighborhood of the ancestrula, where the zooecia are much smaller; it is necessary then to take the measurements on the zoarial margin, where they are of normal size. Again, irregularities of gemmation, whatever the cause, change the number and measurements taken on unoriented cells. Precision in choosing the right place is therefore indispensable. In the Berenicea types this method of evaluation of the number of orifices on a given surface is preferable to the system of micrometric measurements.

TERMINOLOGY

The terminology of the Bryozoa is so special that for the sake of completeness we have introduced the following definitions:

Ancestrula: First cell (derived from the larva) of a colony.

Anter: Superior distal portion of the apertura.

Apertura: Orifice of the cells through which the animals extend their tentacles; it is closed by an operculum in the Cheilostomata.

Ascopore: Frontal pore serving as the orifice to the compensatrix.

Avicularium: Small cell without polypide containing muscles producing movement in a mandible, always in the same direction.

Cardelles and Lyrule: Small lateral points placed in the apertura and serving as pivots to the operculum; the lyrule, placed in the middle, limits the movement of the operculum.

Compensatrix: Small membranous sac placed in the cell, which becomes filled with water when the tentacles are extruded. It opens exteriorly in the proximal portion (poster) of the aperture or by a special pore (ascopore).

Costules: Small radiating ridges forming the frontal of the cribrimorph cells; they originate from primitive marginal spines.

CRIBRIMORPHS: Cells with costulated frontals.

CRYPTOCYST: Calcareous lamella bordering the mural rim and serving as a frontal to cells deprived of a compensatrix. Between it and the ectocyst there is a cavity or hypostege operating as a hydrostatic apparatus.

DIETELLAE: Small chambers placed around the cells.

DISTAL: Portion of an image (or of an organ) most distant from the observer.

ECTOCYST: Thin membrane entirely surrounding the colony.

ENDOCYST: Thin inner membrane containing all the organs located in the cell.

ENDOZOOECIAL (or ENTOZOOECIAL): Cavity (ovicelled) located in the interior of the cell.

ESCHARA: Name applied to a free colony formed of two erect lamellae, back to back.

GÉNÉSIES: Cells containing only female organs; they are often deprived of polypides. When they are ovicelled, the ovicell is endozooecial.

GYMNOCYST: Inferior calcified portion of certain Membranipores.

HETEROZOOECIA: Small cells without polypide, or different forms of normal cells.

HYPERSTOMIAL: Placed above the aperture, referring to a form of ovicell.

HYPOSTEGE: Cavity situated between the cryptocyst and the ectocyst.

LACUNAE: Small pores between the costules of the cribrimorph cells.

LUMEN: Clear longitudinal line in the middle of the costules of cribrimorph cells.

MANDIBLE: Small chitinous organ, triangular or rounded, attached to the avicularia. It always moves in the same direction.

OECIOPORE: Orifice of the ovicell of tubular Bryozoa (Cyclostomata). It is surrounded by an oeciostome more or less salient.

OLOCYST: Calcified frontal of a cell provided with a compensatrix. It is always thin and smooth.

ONYCHOCELLARIUM: An avicularium in which the mandible is provided with lamellar expansions.

OPERCULUM and OPERCULAR VALVE: Small chitinous organ closing the orifice of the cells.

OPESIULES and OPESIULAR INDENTATIONS: Small perforations in the cryptocyst for the passage of the muscles attached to the ectocyst.

OPESIUM: Large orifice left on the Membranipore cells after the disappearance of the chitinous ectocyst.

ORAL: Any organ (spines, avicularia, mucron, etc.) placed in the neighborhood of the aperture.

ORIFICE: Aperture of the tubular cells.

OVICELL: Chamber of incubation for the embryo until its metamorphosis into a free larva. It is formed of two lamellae, the ectoecium and entoecium.

PERICYST: Calcified frontal in certain families never covered by the membranous ectocyst.

PERIPORES: Pores of the frontal surrounded by a salient circle.

PERISTOME: Salient calcification around the aperture or a pore. Its orifice is the peristomice; the exterior free portion is the peristomie.

PLEUROCYST: Calcareous pellicle generally granular, placed on the olocystal frontal of a cell surrounded by areolar pores.

POLYPIDE: Animal with tentacles placed in the interior of the cell and of the tubes. It has a mouth, a stomach, an intestine, and an anus.

POSTER: Anterior proximal portion of the apertura.

PROTOECIUM: Small initial disk of the ancestrula of a tubular colony (Cyclostomata).

Regeneration: A phenomenon particular to the Bryozoa. A dead polypide in a cell is expelled in the form of a brown body and is replaced by another polypide. The latter often produces a secondary calcification visible exteriorly, which permits the recognition of this phenomenon in fossil species. The polypide may be replaced by an avicularium.

Rimule: Posterior small tongue observed often on the operculum.

Sclerite: Marginal thickening of the operculum.

Sinus: Proximal indentation in the aperture, corresponding to the rimule of the operculum. It is the orifice of the compensatrix. The operculum closes at the same time as the cell, the orifice of the tentacles, and that of the compensatrix.

Septulae: Very small perforations in the walls of the cells, serving for the passage of the mesenchymatous fibers. They are uniporous or multiporous.

Spicules: Small spines without internal canal.

Spines: Small hollow projections more or less long. They are marginal when placed around the cells and oral when around the aperture.

Spiramen: Orifice opening into the peristomic above the operculum.

Sulci: Longitudinal furrows decorating the Horneridae and some other tubular Bryozoa.

Tentacles: Small ciliated arms serving in the nutrition of the polypide. They do not capture the plankton, but they are cilia that by their synchronous vibrations direct the water toward the mouth.

Tremocyst: Perforated frontal of the cell. The perforations are the tremopores.

Vacuoles: Small perforations opening at the bottom of the sulci.

Vibracularium: Small special cell without polypide. It contains the muscles for the movement of the vibraculum.

Vibraculum: A cilium of more or less length moving in every direction.

Vincularian: Name applied to a colony with cylindrical growth form.

Zoarium: Colony.

Zooecium: Cell.

ALPHABETICAL LIST OF VINCENTOWN LIMESAND BRYOZOA, SHOWING GEOGRAPHIC DISTRIBUTION

(V=Vincentown, N.J.; T=Timber Creek and Mullica Hill, N.J.; B=near Blackwoodstown, N.J.; N=Noxontown Millpond, Del.; O=2 miles southwest of Odessa, in branch of Oppoquinimink Creek, Del.)

Cheilostomata

Acanthionella typica Gabb and Horn, 1862 (V, T, B, N, O).
Aeolopora grandis, new species (V, B).
Alderina rustica D'Orbigny, 1852 (V, B, N, O).
Alderina welleri, new species (V, N).
Allantopora annuloidea Ulrich and Bassler, 1907 (V).
Allantopora irregularis Gabb and Horn, 1860 (V, T, B).
Amphiblestrum(?) *abortivum* Gabb and Horn, 1862 (V, T, B).
Anornithopora(?) *fragilis*, new species (V).
Aplousina contumax, new species (V, B).
Aplousina disjuncta Gabb and Horn, 1862 (V, B).
Beisselina intermedia, new species (V).

Beisselina labiata Gabb and Horn, 1862 (V, T, B).
Beisselina lonsdalei, new species (V, B).
Beissclina mortoni, new species (V, B).
Callopora jerseyensis Ulrich and Bassler, 1907 (V).
Callopora noxontownensis, new species (N).
Coscinopleura digitata Morton, 1834 (V, T, B).
Cranosina altimuralis Ulrich and Bassler, 1907 (V, N, O).
Crassimarginatella intermedia, new species (V, B).
Crassimarginatella nematoporoides Ulrich and Bassler, 1907 (V).
Dacryopora(?) *orbifera*, new species (N).
Diacanthopora abbottii Gabb and Horn, 1862 (V, T, B, N).
Diacanthopora convexa, new species (V).
Diacanthopora distans Gabb and Horn, 1862 (V, T, B).
Diacanthopora marginata Gabb and Horn, 1862 (T).
Diplotresis sparsiporosa Ulrich and Bassler, 1907 (V, O).
Distansescharella lata, new species (V, N).
Distansescharella pumila Gabb and Horn, 1862 (V, T, B).
Ellisinidra heteropora Gabb and Horn, 1862 (V, N, O).
Euritina torta Gabb and Horn, 1862 (V, T, B).
Exochella septentrionalis, new species (V, B, N, O).
Floridina subscutata, new species (N).
Hesperopora occidentalis Lang, 1916 (B).
Hippaliosina aspera Gabb and Horn, 1862 (V, T, B, N).
Hippothoa tenuichorda Ulrich and Bassler, 1907 (V).
Kelestoma simplex, new species (V).
Kleidionella(?) *trabeculifera*, new species (V).
Lagynopora americana, new species (N).
Membranipora nellioides, new species (V).
Membraniporidra perampla Gabb and Horn, 1862 (V, B).
Micropora cylindracea Ulrich and Bassler, 1907 (V).
Micropora ogivalina, new species (V, N).
Micropora parva, new species (N).
Micropora(?) *pulchra* Ulrich and Bassler, 1907 (V).
Mollia lacessitor, new species (V).
Mollia parvicella, new species (N, O).
Monoporella(?) *laticella*, new species (V).
Monoporella(?) *vincentownensis* Ulrich and Bassler, 1907 (V, B).
Nannopora(?) *minimora*, new species (V).
Perigastrella exserta Gabb and Horn, 1862 (V, T, N).
Periporosella(?) *plebeia* Gabb and Horn, 1862 (V, T, B, N).
Pliophloea elegans, new species (N).
Pliophloea sagena Morton, 1834 (V, T, B, N).
Pliophloea ventricosa, new species (V, N).
Polycephalopora birostrata, new species (V).
Psiloseeos muralis Gabb and Horn, 1862 (V, T, B).
Rhagasostoma americana, new species (N).
Rhiniopora parvirostrata, new species (N).
Rhiniopora tubulosa, new species (V).
Setosinella prolifica, new species (V).
Stamenocella oculata Ulrich and Bassler, 1907 (V, B).
Stichocados compositus Lang, 1916 (V, B).

Stichocados mucronatus, new species (V).
Tricephalopora acutirostris, new species (V, B).
Tricephalopora incrassata, new species (V, N).
Tricephalopora prolifera Gabb and Horn, 1862 (V, B, N, O).
Vincularia acutirostris, new species (V).

CYCLOSTOMATA

Diaperoecia americana Gabb and Horn, 1862 (V, T, B).
Diaperoecia saillans Canu and Bassler, 1922 (V).
Diplosolen lineatum Gabb and Horn, 1862 (V, T, B).
Discocytis eccentrica Ulrich and Bassler, 1907 (V, B).
Entalophora conradii Gabb and Horn, 1862 (V, T, B).
Filifascigera megacra Lonsdale, 1845 (V, T, B, N).
Idmonea (Heterocrisina) abbotti Gabb and Horn, 1860 (V, T, B).
Leiosoecia parvicella Gabb and Horn, 1860 (V, T, B).
Lekythionia dichotoma Gabb and Horn, 1862(V, T, B).
Lichenopora papyracea D'Orbigny, 1852 (V, N).
Onconsoecia bifurcata Ulrich and Bassler, 1907 (V, B).
Oncousoecia contortilis Lonsdale, 1845 (V, T, B).
Plagioecia americana Ulrich and Bassler, 1907 (V, B, N).
Plagioecia varians Ulrich, 1901 (V, B).
Retelea ovalis Gabb and Horn, 1862 (V, T, B, N).
Stathmopora gabbiana Ulrich and Bassler, 1907 (V, B).
Stomatopora kümmelli Ulrich and Bassler, 1907 (V, B).
Stomatopora regularis Gabb and Horn, 1862 (V, B, N).

The following list is introduced for comparison with the Vincentown fauna:

Lowest Eocene (Bryozoan bed of Aquia formation), Upper Marlboro, Md. Species marked with an asterisk (*) occur also in the Vincentown limesand

CHEILOSTOMATA

Acanthionella simplex Canu and Bassler, 1920 (allied to *A. typica* Gabb and Horn, 1862).
Bathosella aspera Ulrich, 1901.
Cheilopora (Lepralia) labiosa Ulrich, 1901.
**Coscinopleura digitata* Morton, 1834.
Ellisina spiculosa Ulrich, 1901.
**Ellisinidra (Amphiblestrum) heteropora* Gabb and Horn, 1862.
**Euritina torta* Gabb and Horn, 1862.
**Hippaliosina aspera* Gabb and Horn, 1862 (*Lepralia subplana* Ulrich, 1901).
Lunularia reversa Ulrich, 1901.
Membraniporella crassula Ulrich, 1901.
Membraniporella modesta Ulrich, 1901.
Membraniporina rimulata Ulrich, 1901.
Monoporella (Macropora) aquia Canu and Bassler, 1920 (allied to *M. vincentownensis* Ulrich and Bassler, 1907).
Periporosella (Ellisina) angusta Ulrich, 1901 (allied to *P. plebeia* Gabb and Horn, 1862).
Ramphonotus laevis Canu and Bassler, 1920.
Stamenocella cylindrica Canu and Bassler, 1920 (allied to *S. oculata* Ulrich and Bassler, 1907).

CYCLOSTOMATA

Ceriopora micropora Goldfuss (?) (not a bryozoan).
Diplosolen compactum Canu and Bassler, 1920.
Heteropora tecta Ulrich, 1901.
**Lekythionia dichotoma* Gabb and Horn, 1862.
Partretocycloecia (*Cavaria*) *dumosa* Ulrich, 1901.
Plagioecia (*Fascipora*) *subramosa* Ulrich, 1901 (probably *Diaperoecia americana* Gabb and Horn, 1862).
**Plagioecia* (*Discosparsa*) *varians* Ulrich, 1901.

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1920. North American Early Tertiary Bryozoa. U.S. Nat. Mus. Bull. 106, 879 pp., 279 figs., 162 pls.

The following Vincentown limesand species are described and illustrated: *Coscinopleura digitata* Morton, 1834; *Acanthionella typica* Gabb and Horn, 1862; *Leiosoecia parvicella* Gabb and Horn, 1860; *Oncousoecia bifurcata* Ulrich and Bassler, 1907; *Amphiblestrum heteropora* Gabb and Horn, 1862 (=*Ellisinidra heteropora*); *Euritina torta* Gabb and Horn, 1862; *Meniscopora subplana* Ulrich, 1902 (=*Hippaliosina aspera*); *Plagioecia subramosa* Ulrich, 1901 (=*Diaperoecia americana*); *Discosparsa varians* Ulrich, 1901 (=*Plagioecia varians*); *Lekythionia dichotoma* Gabb and Horn, 1862.

1922. Studies on the cyclostomatous Bryozoa. Proc. U.S. Nat. Mus., vol. 61, art. 22, pp. 1–160, pls. 1–28.

Oncousoecia bifurcata Ulrich and Bassler, 1907; *Plagioecia varians* Ulrich, 1901; *P.* (*Bercnicea*) *americana* Ulrich and Bassler, 1907; *Stathmepora gabbiana* Ulrich and Bassler, 1907; *Diaperoecia saillans*, new species; *D.* (*Fascipora*) *americana* Gabb and Horn, 1862; *Diplosolen* (*Diastopora*) *lineatum* Gabb and Horn, 1862; *Discocytis* (?) *eccentrica* Ulrich and Bassler, 1907; *Leiosoecia* (*Multicrescis*) *parvicella* Gabb and Horn, 1860.

CONRAD, TIMOTHY ABBOTT, *in* COOK, GEORGE H.

1868. Synopsis of invertebrate fossils, Cretaceous and Eocene. Geol. Surv. New Jersey, pp. 721–732. (Lists only.)

CREDNER, H.

1870. Die Kreide von New Jersey. Zeitschr. Deutschen Geol. Ges., vol. 22, pp. 191–251, pl. 4.

Ditaxia compressa Goldfuss and *Eschara dichotoma* Goldfuss, referring probably to *Pliophloca sagena* and *Coscinopleura digitata*.

GABB, WILLIAM M., and HORN, GEORGE H.

1860. Descriptions of new Cretaceous corals from New Jersey. Proc. Acad. Nat. Sci. Philadelphia, vol. 12, pp. 366, 367.

Hippothoa irregularis, new species (=*Allantopora irregularis*); *Cellepora bilabiata*, new species (unrecognizable; name changed to *Cellepora prolifica* in 1862); *C. carinata*, new species (unrecogni-

zable; see Ulrich and Bassler, *in* Weller, 1907, for bibliography); *C. typica*, new species (=*Acanthionella typica*); *Reticulipora sagena*, new species (not recognizable); *Reptomulticava cepularis*, new species (not recognizable); *Multicrescis parvicella*, new species (=*Leiosoccia parvicella*). Localities not given.

1860. Descriptions of new species of American Tertiary and Cretoceous fossils. Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, pp. 375–404.

The following species are described from the Cretaceous of Timber Creek and from near Mullica Hill, N.J.: *Hippothoa irregularis* Gabb and Horn, 1860 (=*Allantopora irregularis*); *Cellepora bilabiata* Gabb and Horn, 1860; *C. carinata* Gabb and Horn, 1860; *C. typica* Gabb and Horn, 1860 (=*Acanthionella typica*); *Reticulipora sagena* Gabb and Horn, 1860; *Reptomulticava cepularis* Gabb and Horn, 1860; *Multicrescis parvicella* Gabb and Horn, 1860 (=*Leiosoecia parvicella*); *Acerviclausa vermicularis*, new genus and species (not recognizable); *Heterocrisina abbottii*, new genus and species.

1862. Monograph of the fossil Polyzoa of the Secondary and Tertiary formations of North America. Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, pp. 111–178, pls. 19–21.

The following species are described from the Cretaceous of Timber Creek and near Mullica Hill, N.J.: *Eschara digitata* Morton, 1834 (=*Coscinopleura digitata*); *Cellepora prolifica* Gabb and Horn, 1862 (undeterminable; first described as *Cellepora bilabiata* Gabb and Horn, 1860); *C. exserta*, new species (=*Perigastrella exserta*); *C. pumila*, new species (=*Distanscscharella pumila*); *Reptocclleporaria aspera*, new species (=*Hippaliosina aspera*); *Escharinella muralis*, new species (=*Psilosccos muralis*); *Reptescharellina prolifera*, new species (=*Tricephalopora prolifera*); *Escharipora typica* Gabb and Horn (=*Acanthionella typica*); *E. distans*, new species (=*Diacanthopora distans*); *E. abbottii*, new species (=*Diacanthopora abbottii*); *E. immersa*, new species (undeterminable; see Ulrich and Bassler, 1907, for bibliography); *Pliophloea sagena* Morton, 1834; *Repteschariporа marginata*, new species (=*Diacanthopora marginata*); *Biflustra torta*, new species (=*Euritina torta*); *B. disjuncta*, new species (=*Aplousina disjuncta*); *Pyripora irregularis* Gabb and Horn, 1860 (=*Allantopora irregularis*); *Membranipora abortiva*, new species (=*Amphiblestrum abortivum*); *M. perampla*, new species (=*Membraniporidra perampla*); *Membranipora plebeia*, new species (=*Periporosella plebeia*); *Flustrella capistrata*, new species (=*Amphiblestrum abortivum*); *F. cylindrica*, new species (possibly *Stamenocella oculata* Ulrich and Bassler, 1907); *Reptoflustrella heteropora*, new species (=*Ellisinidra heteropora*); *Retelca ovalis*, new species; *Filifascigera megaera* Lonsdale, 1845; *Fascipora americana*, new species (=*Diaperoecia americana*); *Spiropora calamus*, new species (not rediscovered); *Idmonea contortilis* Lonsdale, 1845 (=*Oncousoccia contortilis*); *Entalophora quadrangularis*, new species (not recognized; possibly *Ochetosella jacksonica* of the Eocene); *E. conradii*, new species; *Diastopora lineata*, new species (=*Diplosolen lineatum*); *Stomatopora regularis*, new species;

Reticulipora dichotoma, new species (=*Lekythionia dichotoma*); *R. sagena* Gabb and Horn, 1860 (not recognizable); *Bicrisina* (*Heterocrisina*) *abbottii* Gabb and Horn, 1860 (=*Idmonea* (*Heterocrisina*) *abbotti*); *Reptomulticava cepularis* Gabb and Horn, 1860 (not recognized); *Crescis labiata*, new species (=*Beisselina labiata*); *Multicrescis parvicella* Gabb and Horn, 1860 (=*Leiosoecia parvicella*).

JOHNSON, CHARLES WILLISON.

1905. Annotated list of the types of invertebrate Cretaceous fossils in the collection of the Academy of Natural Sciences. Proc. Acad. Nat. Sci. Philadelphia, vol. 57, pp. 4–28.

LANG, W. D.

1921. Catalogue of Cretaceous Bryozoa, vol. 3, The Cribrimorphs, part 1, xcvi+267 pp., 115 figs., 8 pls.

Pliophloea sagena Morton, 1834.

1922. Catalogue of Cretaceous Bryozoa, vol. 4, The Cribrimorphs, part 2, 403 pp., 125 figs., 8 pls.

Diacanthopora abbottii Gabb and Horn, 1862; *Stichocados compositus* Lang, 1916; *Hesperopora occidentalis* Lang, 1916; *Tricephalopora prolifera* Gabb and Horn, 1862; *Diacanthopora marginata* Gabb and Horn, 1862; *D. distans* Gabb and Horn, 1862.

LONSDALE, WILLIAM.

1845. Account of six species of Polyparia obtained from Timber Creek, New Jersey. Quart. Journ. Geol. Soc. London, vol. 1, pp. 65–75, 22 figs. in text.

Idmonea contortilis, new species (=*Oncousoecia contortilis*); *Tubulipora megaera*, new species (=*Filifascigera megaera*); *Cellepora tubulata*, new species (not recognized); *Escharina sagena* Morton, 1834 (=*Pliophloea sagena*); *E. digitata* Morton, 1834 (=*Coscinopleura digitata*).

MEEK, FIELDING BRADFORD.

1864. Check list of the invertebrate fossils of North America. Cretaceous and Jurassic. Smithsonian Misc. Coll., vol. 7, no. 177, 40 pp.

MORTON, SAMUEL G., *in* VANUXEM and MORTON.

1829. Observations on the geology and organic remains of the Secondary, Tertiary, and Alluvial formations of the Atlantic Coast of the United States of America. Philadelphia. Extract from Journ. Acad. Nat. Sci. Philadelphia, vol. 6, pp. 120–129.

Contains a notice of some fossils recently discovered in New Jersey. On page 62 the author records the occurrence of fragments of *Eschara*, *Flustra*, and *Retepora* from the pits on Big Timber Creek, N.J.

MORTON, SAMUEL G.

1830. Synopsis of the organic remains of the ferruginous sand pits of the United States. Amer. Journ. Sci. and Arts, ser. 1, vol. 17, pp. 274–295.

On page 288 the author notes the occurrence of fragments of *Eschara*, *Flustra*, and *Retepora* from Gloucester County, N.J.

MORTON, SAMUEL G.—Continued

1834. Synopsis of the organic remains of the Cretaceous group of the United States, pp. 88–96, 19 plates. Philadelphia.

The Bryozoa described are *Eschara digitata*, new species (=*Coscinopleura digitata*) and *Flustra sagena*, new species (=*Pliophloea sagena*), both from the Cretaceous of New Jersey.

ULRICH, EDWARD OSCAR, *in* ZITTEL.

1896. Textbook of paleontology, ed. 1. Translated and edited by Charles R. Eastman, fig. 451.

Filifascigera megaera Lonsdale, 1845.

1913. Textbook of paleontology, ed. 2.

Filifascigera megaera Lonsdale, 1845.

ULRICH, EDWARD OSCAR.

1901. Maryland geological survey, Eocene, vol. 1, pp. 205–222, pls. 49, 50.

Describes fauna from the Aquia Formation, Upper Marlboro, Md., containing the following Vincentown species: *Discosparsa varians*, new species (=*Plagioecia varians*); *Fascipora subramosa*, new species (=*Diaperoecia americana*); *Reticulipora dichotoma* Gabb and Horn, 1862 (=*Lekythionia dichotoma*); *Reptoflustrella heteropora* Gabb and Horn, 1862 (=*Ellisinidra heteropora*); *Biflustra torta* Gabb and Horn, 1862 (=*Euritina torta*); *Eschara* (?) *digitata* Morton, 1834 (=*Coscinopleura digitata*); *Lepralia subplana*, new species (=*Hippaliosina aspera*).

ULRICH, EDWARD OSCAR, and BASSLER, RAY SMITH.

1907. Bryozoa; *in* Weller, Geological Survey of New Jersey, Paleontology, vol. 4 (Cretaceous faunas), pp. 307–356, pls. 20–26.

Describes the previously known species of Cyclostomata and Cheilostomata of the Vincentown limesand and in addition the following new species: *Stomatopora kümmelli*, new species; *S. temnichorda*, new species (=*Hippothoa tenuichorda*); *Berenicea americana*, new species (=*Plagioecia americana*); *Bisidmonea gabbiana*, new species (=*Stathmepora gabbiana*); *Crisina striatopora* Ulrich, 1904 (identified by error in Vincentown limesand); *Filisparsa bifurcata*, new species (=*Oncousoecia bifurcata*); *Discocytis eccentrica*, new species; *Membranipora annuloidea*, new species (=*Allantopora annuloidea*); *M. nematoporoides*, new species (=*Crassimarginatella nematoporoides*); *M. jerseyensis*, new species (=*Callopora jerseyensis*); *Porina coronata* Reuss (?) (=*Beisselina lonsdalei*); *Escharinella altimuralis*, new species (=*Cranosina altimuralis*); *Micropora cylindracea*, new species; *M. pulchra*, new species; *M. vincentownensis*, new species (=*Monoporella vincentownensis*); *M. sparsiporosa*, new species (=*Diplotresis sparsiporosa*).

SYSTEMATIC DESCRIPTIONS

Order CHEILOSTOMATA Busk

Suborder ANASCA Levinsen

Family BIFLUSTRIDAE Smitt, 1872

Genus MEMBRANIPORA Blainville, 1830

MEMBRANIPORA NELLIOIDES, new species

PLATE 1, FIGURES 2, 3

Description.—The zoarium is articulated; the segments are small, quadriserial. The zooecia are distinct, much elongated, separated by a deep furrow, elliptical and provided with a proximal gymnocyst. The mural rim is quite thin at the top and much enlarged at the base. The gymnocyst is covered by two avicularian chambers symmetrically arranged; the avicularia, thus arranged in longitudinal rows, are very salient, funnel-shaped, supplied with a pivot, and their beak is oblique and slightly rounded at the extremity.

Measurements.[4]—

Opesium $\begin{cases} ho = 0.4 \text{ mm.} \\ lo = 0.15 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz = 0.7 \text{ mm.} \\ lz = 0.25 \text{ mm.} \end{cases}$

Affinities.—The structure of this species is identical with that of *Membranipora lusoria* Waters, 1881, from the Miocene of Australia, which has not been rediscovered. Since we have only two specimens of *Membranipora nellioides*, it is impossible to classify the species more definitely. It is possible that these two species belong to the genus *Nellia* Busk, 1852.

Occurrence.—Vincentown limesand: Vincentown, N.J. (very rare).

Cotypes.—U.S.N.M. No. 73859.

Genus VINCULARIA Defrance, 1829

VINCULARIA ACUTIROSTRIS, new species

PLATE 1, FIGURE 1

Description.—The zoarium is free, vincular in form, pentagonal, articulated. The zooecia are elongated, oval, arranged in longitudinal series; the mural rim is thin, little salient; the proximal cryptocyst is small, concave, smooth. The outer opesium is large

[4] In the citation of measurements, *ho* is the length and *lo* the width of the opesia, *Lz* and *lz* similarly the length and width of the zooecia, *Lv* and *lv* the same for the vibraculum, *Lon* and *lon* for the onychocellaria, *ha* and *la* for the apertura, etc.

and of the same form as the zooecium; the inner opesium is small, elliptical, elongated, visible above the cryptocyst; the latter is surmounted by a broad distal shelf, perforated by two large septulae. The avicularia are interzooecial, lozenge-shaped with a sharply pointed beak; they are also arranged in longitudinal rows.

Measurements.—

Inner opesium $\begin{cases} ho = 0.12\text{–}0.15 \text{ mm.} \\ lo = 0.08 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.5 \text{ mm.} \\ lz = 0.3 \text{ mm.} \end{cases}$

Structure.—The structure with double opesia characterizes the family of the Synaptacellidae Maplestone, 1911, but it is also visible in some species of the Scrupocellariidae Levinsen, 1909. It can be observed in the following species:

Heterocella (?) *pentagona* Canu and Bassler, 1929, from the Philippines, which has no avicularia. *Vincularia grama* Brydone, 1930, from the English Senonian has two to four septulae on the distal broad shelf, no avicularia, and an endozooecial ovicell.

Membranipora cingulata Levinsen, 1925, of the European Danian has an identical zooecial structure, but here the ovicell is also unknown.

Scrupocellaria ferox Busk, 1852, as figured by Canu and Bassler, 1929, is a recent species presenting all the characters of the genus *Scrupocellaria.*

Actually, then, there is no genus for the reception of this small species. The rarity of specimens prevents us from making the sections necessary to determine its structure.

A similar broad distal shelf, but not perforated by the septulae, is observable in *Eschara erina* D'Orbigny, 1852, from the French Senonian and in the recent species *Caberea brevigaleata* Canu and Bassler, 1929, from the Philippines, *Canda arachnoides* Lamouroux, 1816, and *Scrupocellaria scrupea* Busk, 1848.

Very probably the genus *Synaptacella* Maplestone, 1911, would therefore be more correctly placed in the Scrupocellariidae. The fossil species cited, *Vincularia grama*, *Vincularia acutirostris*, and *Eschara erina* would be the Cretaceous ancestors of this family.

Occurrence.—Vincentown limesand: Vincentown, N.J. (very rare).

Holotype.—U.S.N.M. No. 73858.

Family HINCKSINIDAE Canu and Bassler, 1927

Genus APLOUSINA Canu and Bassler, 1927

APLOUSINA CONTUMAX, new species

PLATE 1, FIGURES 4–7

Description.—The zoarium encrusts fragments of shells and of *Coscinopleura.* The dorsal is a very thin pellicle covering only the smallest perforations of the substratum. The zooecia are large, ir-

regularly hexagonal, separated by a furrow; the mural rim is thin, convex, regular; the opesium is large and of the same form as the zooecium. There is a large distal septula. The ovicell is very small and endozooecial. The ancestrula is elliptical, elongated, with a large calcified cryptocyst; its opesium is terminal semielliptical. Frequently there are irregular zooecia. Gemmation is little regular.

Measurements.—

Opesium $\begin{cases} ho = 0.55\text{–}0.65 \text{ mm.} \\ lo = 0.4 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.7\text{–}0.85 \text{ mm.} \\ lz = 0.6 \text{ mm.} \end{cases}$

10 zooecia in 4 square mm.

Affinities.—This fine species presents some remarkable characters—the large distal septula, the dorsal pellicle very thin or absent, and the irregular gemmation. These characters are found also in *Membranipora fulgora* Brydone, 1916, from the English Senonian, but here the ovicell is not known and there are large interzooecial avicularia.

There are 6 ancestrular cells, one of which is incomplete. The irregular cells, quite variable in size, appear to be accessory cells necessitated by the irregularity of the ordinary gemmation on the very uneven substratum. Regenerated cells occur.

Occurrence.—Vincentown limesand: Vincentown and near Blackwoodstown, N.J. (rare).

Cotypes.—U.S.N.M. Nos. 73861, 73862.

APLOUSINA DISJUNCTA Gabb and Horn, 1862

PLATE 2, FIGURES 1–6

1862. *Biflustra disjuncta* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 162, pl. 20, fig. 50.

1907. *Biflustra disjuncta* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 333, pl. 23, fig. 13 (bibliography).

Description.—The zoarium is bifoliate, compressed, of dichotomous fronds; the two lamellae back to back are adherent or separable. The zooecia are robust, separated by a little salient thread, elongate-hexagonal in outline, growing in longitudinal series and arranged in quincunx; the cryptocyst is convex, very finely granular and encircles the opesium laterally; the intercellular calcification, often incomplete, occasions a partial or total disjunction. The zooecial walls are independent of each other and bear two small uniporous septulae. The opesium is large, terminal elliptical, elongated, somewhat variable in form. The ovicell is endozooecial, very little convex and covers simply the distal portion of the opesium. There are regenerated zooecia.

Measurements.—

Opesium $\begin{cases} ho = 0.65 \text{ mm.} \\ lo = 0.35 \text{ mm.} \end{cases}$ Zooecia $\begin{cases} Lz = 0.85 \text{ mm.} \\ lz = 0.55 \text{ mm.} \end{cases}$

Variations.—The zooecial and opesial variations are great, but the micrometric measurements vary little from those given above, which have been taken on the larger cells.

The phenomenon of the partial cellular disjunction is quite characteristic. Not only is it apparent on the frontal in the interruption of calcification, but it shows still better on the dorsal of the separable lamellae. It has its origin in the independence of the walls of each zooecium, which are never intimately united to those of adjacent zooecia.

The gemmation is very regular; the new series arises by the simple division into two of a distal zooecium.

The regenerated zooecia have a very thick inner mural rim and the new opesium is much smaller than the old one. They are often primoserial.

The cellular disjunction is not apparent on all the fronds, in which case the general aspect is very artistic and regular.

Occurrence.—Vincentown limesand: Vincentown (common) and near Blackwoodstown (rare), N.J.

Plesiotypes.—U.S.N.M. Nos. 73863, 73864.

Family ALDERINIDAE Canu and Bassler, 1927

CRANOSINA,[5] new genus

The ovicell is endozooecial. A setiform transverse avicularium surmounts each zooecium. The dietellae are extremely conspicuous and about four in the distal half of the lateral wall, their openings to the zooecia often large.

Genotype.—*Cranosina* (*Membranipora*) *coronata* Hincks, 1881.

Range.—Cretaceous (Senonian) to Recent (Equatorial zone).

The known species of this genus are as follows:

C. (*Membranipora*) *coronata* Hincks, 1881_____ Recent (Equatorial zone).
C. (*Ellisina*) *philippinensis* Canu and Bassler, 1929____ Recent (Philippines).
C. (*Ellisina*) *lata* Canu and Bassler, 1920_____ Eocene (Jacksonian).
C. (*Ellisina*) *brevis* Canu and Bassler, 1920_____ Eocene (Jacksonian).
C. (*Escharinella*) *altimuralis* Ulrich and Bassler, 1907
Cretaceous (Vincentown).
C. (*Membranipora*) *alumensis* Brydone, 1929_____ Cretaceous (Senonian).

History.—In 1903 Norman created the genus *Ellisina* based on characters of secondary or debatable value. He gave a list of species, which deceived Canu and Bassler in 1920, Harmer in 1926, and Voigt in 1930. In 1929 in our Philippine monograph (p. 105), we wrote, after the justified criticism of Harmer: "We could separate a special group having an endozooecial ovicell and a vibraculoid

[5] From κράνος, crest, in allusion to the place of the avicularia.

(setiform) distal avicularium * * * for which we might propose a special genus, clearly equatorial * * *."

The type of the genus *Ellisina* is *Membranipora levata* Hincks, 1882,[6] in which the ovicell is hyperstomial and closed by the operculum. The *coronata* group is not then the *levata* group in spite of exterior appearances.

Affinities.—*Cranosina* differs from *Ellisina* Norman, 1903, in the presence of an endozooecial ovicell. It differs from *Setosellina* Calvet, 1907, in the occurrence of a distal, transverse avicularium and not a longitudinal vibraculum. In the list of Cretaceous *Ellisina* given by Voigt, 1930, all three genera appear to be represented.

CRANOSINA ALTIMURALIS Ulrich and Bassler, 1907

PLATE 2, FIGURES 7, 8

1907. *Escharinella altimuralis* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 339, pl. 24, figs. 9, 10.

Description.—The zoarium encrusts the debris of shells and Bryozoa; the dorsal is a very thin pellicle incompletely covering the substratum. The zooecia are adjacent, not separated, subrhomboidal in outline with very thin walls; the opesium is of the same form as the zooecium. There are four pairs of small septulae widely opened. The ovicell is endozooecial, small, and convex and covers the two distal septulae. Each zooecium is surmounted by a small triangular avicularium, oblique, oriented a little upward, symmetrical, with two denticles for pivot; its surface, oriented toward the proximal zooecium, is oblique to the plane of the latter; the beak is pointed and very salient.

Measurements.—

Zooecium { Lz=0.5–0.63 mm. / lz=0.36–0.41 mm. } 20 or 21 zooecia in 4 sq. mm.

Variations.—The micrometric variations are very great, for on the same colony the zooecia range from 0.5 to 0.75 mm in length and from 0.25 to 0.5 mm in width. The irregularities of the substratum often give to the cells a most fantastic aspect.

Occasionally the ovicell is surmounted by an avicularium, which covers it with a secondary calcification.

We have observed the phenomenon of a double ancestrula, but we have not seen regenerated zooecia.

Occurrence.—Vincentown limesand: Very common at Vincentown, N.J., but rare at Noxontown Millpond and near Odessa, Del.

Holotype and plesiotype.—U.S.N.M. Nos. 52594, 73866.

[6] Miss Hastings, in 1930, published a good study of *Ellisina levata:* Cheilostomatous Polyzoa from the vicinity of the Panama Canal. Proc. Zool. Soc. London, 1929, p. 713, pl. 8, figs. 36, 37.

Genus MEMBRANIPORIDRA Canu and Bassler, 1917

MEMBRANIPORIDRA PERAMPLA Gabb and Horn, 1862

PLATE 3, FIGURES 1, 2

1862. *Membranipora perampla* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 158, pl. 20, fig. 42.

1907. *Membranipora perampla* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 337, pl. 24, fig. 4 (bibliography).

Description.—The zoarium is encrusting, growing upon other Bryozoa and upon shells. The zooecia are distinct, large, separated by a furrow, hexagonal in outline, arranged in quincunx; the mural rim is thick, more or less enlarged at the base; the opesium is wide, elliptical or sometimes nearly circular in outline. The ovicell is hyperstomial, buried in the distal zooecium, convex, smooth.

Measurements.—

Opesium { *ho*=0.47–0.54 mm. *lo*=0.36 mm. Zooecium { *Lz*=0.66–0.72 mm. *lz*=0.47–0.54 mm.

Variations.—Gabb and Horn found only a single specimen of their species, exhibiting the enlarged cells of undoubtedly a large colony. As similar cells can be frequently observed on the specimens studied by Ulrich and Bassler, it was with good reason that they selected them as representing the species of the older authors.

As in all the Membranipores, the variations in form and in dimensions are very great. The proximal portion of the mural rim, becoming much enlarged, is transformed into a true cryptocyst and gives to the cells a very different aspect, but precisely that figured by Gabb and Horn.

In appearance the ovicell seems to be endozooecial, but with dissection the distal portion of the mural rim is visible although attenuated, and the ovicell cicatrix surmounts it regularly. This is the characteristic of *Membraniporidra* in which the hyperstomial ovicell is closed by the operculum. On the fossils the distinction between the two kinds of ovicells is often difficult to observe. Here in inclining the preparation one sees clearly under the ovicell the transverse slit through which the ovicelled cavity communicated with the cell. Regenerated zooecia are not rare.

Occurrence.—Vincentown limesand: Very common at Vincentown but rare near Blackwoodstown, N.J.

Plesiotypes.—U.S.N.M. Nos. 52603, 73865.

ELLISINIDRA, new genus

The ovicell is hyperstomial and closed by the operculum. An interzooecial avicularium, small, transverse, dependent, occurs above each zooecium. Dietellae are present.

Genotype.—*Ellisinidra* (*Membranipora*) *levata* Hincks, 1882 (not Norman, 1903).

Range.—Cretaceous (Senonian), Recent.

Historical.—Miss Hastings, 1930, has shown that *Membranipora levata* Norman, 1903, the genotype of *Ellisina*, is not the species of Hincks, 1882. She gives two good figures of the two species and shows the differences. In Norman's specimens the avicularia are adventitious, situated on the proximal gymnocyst. In *E. levata* Hincks they are vicarious, though small, and connected with the surrounding zooecia by pore chambers. Moreover, they depend absolutely from the proximal zooecium, which they constantly crown. We suppose then that they are necessary in the opening of the opercular valve. As this function appears to us indispensable in the life of the cell, we have made Hincks' species the type of our new genus *Ellisinidra*.[7]

Membranipora laximaculata Levinsen, 1925, from the Senonian of Rügen belongs to this genus. Likewise *Amphiblestrum spiculosum* Ulrich, 1901, from the lowest Eocene at Upper Marlboro, Md., might be classed there, but it forms with *Reptoflustrella heteropora* Gabb and Horn, 1862, a group with cells bearing a cryptocyst.

ELLISINIDRA HETEROPORA Gabb and Horn, 1862

PLATE 1, FIGURE 8

1862. *Reptoflustrella heteropora* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 12, pl. 20, fig. 50.

1907. *Amphiblestrum heteropora* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 333 (bibliography).

1920. *Amphiblestrum heteropora* CANU and BASSLER, U.S.Nat.Mus. Bull. 106, p. 158, pl. 1, figs. 11–13.

Description.—The zoarium encrusts shells and other Bryozoa, principally fragments of *Coscinopleura*. The zooecia are distinct, adjacent, elongated, oval, enlarged distally; the mural rim is salient, thin; the cryptocyst is shallow, very little convex, slightly granulated. The opesium is terminal, elongated, semielliptic with a proximal border slightly concave. The ovicell is hyperstomial, embedded in the distal zooecium, closed by the operculum, very convex, smooth. The distal avicularium is small, triangular, transverse or oblique with two small denticles for a pivot.

Measurements.—

Zooecia { Lz=0.54 mm. / lz=0.22–0.3 mm. } Opesium { ho=0.27–0.3 mm. / lo=0.18–0.25 mm. }

28 zooecia in 4 sq. mm.

[7] We employ whenever possible the termination *idra* for a genus that has a hyperstomial ovicell closed by the operculum and *ina* for that in which the ovicell is endozooecial.

Variations.—The micrometric measurements are variable, the largest occurring on the marginal zooecia.

The ovicell appears under the microscope to be endozooecial, as it hides the distal border of the mural rim, but by inclining the preparation it is easy to see the latter attenuated and the orifice of the ovicell placed above the distal septula. In a dissection, the cicatrix left by the ovicell is quite visible on the distal cryptocyst. The figured specimen contains two calcified cells.

Occurrence.—Vincentown limesand: Common at Vincentown, N.J., and at Noxontown Millpond and 2 miles southwest of Odessa, Del.

Geological distribution.—Bryozoan beds at base of Aquia (Eocene), Upper Marlboro, Md.

Plesiotypes.—U.S.N.M. Nos. 73872, 73873.

Genus ALDERINA Norman, 1903

ALDERINA RUSTICA D'Orbigny, 1852

PLATE 3, FIGURES 3, 4

1852. *Membranipora rustica* D'ORBIGNY, Paléontologie française, terrains Crétacés, p. 558, pl. 729, figs. 21–22.

1900. *Membranipora rustica* CANU, Bull. Soc. geol. France, ser. 3, vol. 28, p. 355.

Description.—The zoarium encrusts fragments of shells and Bryozoa. The zooecia are distinct, separated by a furrow, elongated, elliptical; the mural rim is very thin, regular, very finely granulated. The opesium is of the same form as the zooecium. The ovicell is hyperstomial, not closed by the operculum, globular, transverse, often carinated longitudinally.

Measurements.—

Opesium $\begin{cases} ho = 0.5 \text{ mm.} \\ lo = 0.3 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz = 0.6\text{–}0.7 \text{ mm.} \\ lz = 0.3\text{–}0.35 \text{ mm.} \end{cases}$

22 zooecia in 4 sq. mm.

Affinities.—The micrometric measurements remain within those given by Canu, 1900, for *Membranipora rustica* D'Orbigny, 1852. These are variable on the French species, but they appear more regular here, although they are larger in specimens from Vincentown as given above and especially in the specimen from Noxontown.

By inclining the preparation it is easy to verify that the mural rim is complete under the ovicell, which cannot then be closed by the operculum. Dissection confirms this observation. The dorsal pellicle of the cells is very thin. As in the French specimens, the ovicell frequently deforms the opesium of the distal zooecium.

Occurrence.—Vincentown limesand: Rare at Vincentown and near Blackwoodstown, N.J., and at Noxontown Millpond and 2 miles southwest of Odessa, Del.

Geological distribution.—Maastrichtian (Dordonian): Royan, France.

Plesiotype.—U.S.N.M. No. 73876.

ALDERINA WELLERI, new species

PLATE 4, FIGURES 1, 2

Description.—The zoarium encrusts the fragments of shells and of *Coscinopleura*. The zooecia are distinct, separated by a deep furrow, elongated, oval, sometimes with a small gymnocyst; the mural rim is thin distally and much enlarged proximally. The opesium is terminal, oval. The ovicell is hyperstomial, not closed by the operculum, globular, smooth. Very rarely a small interzooecial avicularium appears. There are one large distal septula and two pairs of lateral septulae.

Measurements.—

Ordinary zooecia $\begin{cases} Lz = 0.5–0.55 \text{ mm.} \\ lz = 0.35–0.45 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.35–0.4 \text{ mm.} \\ lo = 0.25–0.3 \text{ mm.} \end{cases}$

Young zooecia (marginal) $\begin{cases} Lz = 0.6–0.75 \text{ mm.} \\ lz = 0.35–0.4 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.4–0.5 \text{ mm.} \\ lo = 0.3–0.35 \text{ mm.} \end{cases}$

17–19 zooecia in 4 sq. mm.

Variations.—The marginal zooecia are larger and their mural rim is thinner. Their ovicells appear exteriorly to be closed by the operculum but in inclining the preparation, one can see the mural rim complete and not attenuated as in *Alderina*, which observation is confirmed by dissection. The small very sporadic interzooecial zooeciules are probably avicularia. Regenerated zooecia are not rare.

We have dedicated this species to the late Dr. Stuart Weller in appreciation of his work upon the Cretaceous faunas of New Jersey.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J., and Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73875.

Genus STAMENOCELLA Canu and Bassler, 1917

STAMENOCELLA OCULATA Ulrich and Bassler, 1907

PLATE 3, FIGURES 5–9; PLATE 15, FIGURE 9

1862. *Flustrella cylindrica* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 161, fig. 49.

1907. *Planicellaria oculata* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 338, pl. 24, figs. 6, 7 (not D'Orbigny, 1852).

Description.—The zoarium is free, radicelled, flabellate formed of two lamellae placed back to back and inseparable, articulated, attached to a chitinous stolon. There are 4 kinds of zooecia as

follows: (1) Zooecia of articulation, the 2 large cells at the base of the segment. These are convex and their opesium is large, elliptical elongated. (2) Radicular zooecia, cells of the base of the segment; they are calcified, convex, perforated in the middle by a round or elliptical orifice. (3) Normal zooecia, distinct, very long, enlarged distally. The mural rim is thin and rounded; the gymnocyst is very narrow and bears an avicularium; the opesium is terminal, large, oval. (4) Regenerated zooecia, cells with a double mural rim and a small median opesium. The avicularium is triangular, with pivot, salient, oblique to the zooecial plane.

Measurements.—

Zooecia $\begin{cases} Lz = 0.8 \text{ mm.} \\ lz = 0.25 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.4 \text{ mm.} \\ lo = 0.14 \text{ mm.} \end{cases}$

Structure.—The zoarium is always flabellate; it begins with 1 cell and ends with 5 or 6; the cells grow in size from the base to the top. The first cell is attached either to a stolon or to another segment by a horny or chitinous joint.

The two premier zooecia at the base of each segment are very broad (0.3 mm); their gymnocyst does not bear an avicularium; their opesium, almost circular, is not terminal, and its diameter corresponds exactly to that of the base of the segments. We can therefore suppose that these are cells of ramification and that their opesium serves only for the passage of the chitinous joints binding the two segments, as in *Cellaria* and *Tubucellaria*. Ramification occurs, then, only at the base of the segment and never at its summit. The extremity of the branches terminates on a basal lamella, as in all the other Membranipores. The articulation is therefore totally different from that of the other jointed species. The zoarium can increase in width but not in length. It does not then fear engulfing, which makes us believe that the initial stolon arising from the ancestrula must have crept on some floating alga.

These two initial cells give rise to the radicular cells. They develop at first as ordinary cells, for a trace of the operculum remains visible, but later they become calcified, and their opesium then allows only radicular fibers to pass. They are numerous and grouped at the base of the segment but they appear sporadically higher up among the normal cells. Small avicularia always exist on this kind of cell, but we do not know whether their function continues after the transformation of the normal cell into the radicular one.

We have observed zoarial fragments composed only of radicular cells, which causes us to believe that the radicells serve also to bind the segments together, as in the genus *Canda*, to give greater cohesion and more resistance to the bushy colony.

The normal zooecia appear only at the summit of the fronds. Their number is always less than that of the radicular zooecia. They increase also from the base to the top, where they attain the dimensions which we have given above and which are the largest that have been observed.

The regenerated zooecia are not rare; but as they appear chiefly in the intermediate zone between the normal and the radicular ones, we may suppose that they are in course of transformation to radicular cells.

The avicularia remain small on the zooecia of the two lamellae, but they are much developed and become large and salient on the lateral zooecia; that is, on the zoarial margins, thus giving to the fronds a very characteristic denticulated aspect, especially in the distal zone of the normal zooecia. The ovicell is unknown.

Biology.—For a long time it was difficult to interpret the curious structure of these small fossils, but with increasing knowledge of recent forms it is easy now to restore them in the imagination. They were small bushes erect and attached in more or less numbers to a chitinous stolon creeping over floating algae and living at some distance from the bottom of the sea. They could increase in width but not in height beyond a centimeter. We find therefore at this period biologic structures very close to those observed in the Recent seas. Also we find apparently justified our observations made in 1920 comparing the genus *Stamenocella* with the recent genus *Bugularia* Levinsen, 1909.

Affinities.—This species is not a *Planicellaria*, for D'Orbigny's genus is biserial, articulated at the top of the segments and not at the base, and the avicularia are exclusively lateral. The cellular structure is here indeed that of *Stamenocella* Canu and Bassler, 1920, the remarkable and very homogeneous genus that Voigt in 1930 has interpreted so well. The genus at present contains 2 species from the Senonian, 2 from the Maastrichtian and 2 from the Danian of Europe, 1 from the Vincentown marl of New Jersey, 1 from the Eocene (Aquia) of Maryland, 1 from the Midwayan, 5 from the Jacksonian, and 4 from the Oligocene (Vicksburgian) of the Southern States. In all, the colonies are free.

Flustrella cylindrica Gabb and Horn has not been reidentified in recent collections, but judged from the original illustration (see pl. 15, fig. 9) it may be the same as the present species.

Occurrence.—Vincentown limesand: Common at Vincentown but rare near Blackwoodstown, N.J.

Cotype and plesiotype.—U.S.N.M. Nos. 52612, 73874.

Genus ALLANTOPORA Lang, 1914

ALLANTOPORA IRREGULARIS Gabb and Horn, 1860

PLATE 4, FIGURE 6

1860. *Hippothoa irregularis* GABB and HORN, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, p. 366.

1907. *Pyripora irregularis* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 337, pl. 24, fig. 5 (bibliography).

1914. *Allantopora irregularis* LANG, Geol. Mag., ser. 6, vol. 1, p. 437, pl. 34, fig. 1 (bibliography).

Description.—The zoarium encrusts other Bryozoa (*Coscinopleura*, *Pliophloea*, etc.) and is uniserial, ramified. The zooecia are robust pyriform, large; the gymnocyst is strongly convex, smooth, very narrow posteriorly; the termen is thick and bears minute granules and four or five pairs of large hollow spines. The opesium is broad, subelliptical in outline, situated anteriorly. The ovicell is hyperstomial, not closed by the operculum, globular, smooth.

Measurements.—

Zooecia $\begin{cases} Lz = 0.8\text{–}0.9 \text{ mm.} \\ lz = 0.4\text{–}06 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.4\text{–}0.45 \text{ mm.} \\ lo = 0.22\text{–}0.25 \text{ mm.} \end{cases}$

Structure.—This pretty species was chosen by Lang in 1914 as the type of his genus *Allantopora*. The description he gave is incomplete, for he did not describe the ovicell. It is hyperstomial; its orifice cannot be closed by the opercular valve.

Two recent species of this genus have been discovered in the equatorial zone. One of these, *Allantopora translucens* Harmer, 1926, bears long articulated spines, so that we are correct in interpreting as hollow spines the minute cicatrices that occur on the termen. Their presence is possibly not a generic character. Harmer's species, which is from Malaysia, was dredged between 75 and 94 meters. *Allantopora curta* Canu and Bassler, 1929, from the Philippines occurred at two localities, at depths of 176 meters and 386 meters. The genus appears to be one of deep water. To judge from these, the Vincentown marl fossils may then have been deposited at a depth of 90 meters at least, with a temperature perhaps of about 20° C. We have observed regenerated zooecia. Besides the above, other representatives of the genus are *Allantopora stomatoporoides* Lang, 1914 (Danian), *A. senoniensis* Voigt, 1930 (Senonian), and in addition some multiserial species.

Occurrence.—Vincentown limesand: Timber Creek and Mullica Hill, N.J. (Gabb and Horn); somewhat rare at Vincentown and near Blackwoodstown, N.J.

Plesiotypes.—U.S.N.M. Nos. 52615, 73860.

ALLANTOPORA ANNULOIDEA Ulrich and Bassler, 1907

PLATE 4, FIGURES 3–5

1907. *Membranipora annuloidea* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 335, pl. 23, fig. 18.

Description.—The zoarium encrusts the debris of shells and ramose Bryozoa. The zooecia are distinct, separated by a deep furrow, somewhat elongated, pyriform; the gymnocyst is short, smooth, convex, thick, more or less narrowed in the proximal portion. The termen is thick, rounded, finely granular, and bears five pairs of large hollow spines. The opesium is anterior, elongated, elliptical, or oval. The ovicell is hyperstomial, not closed by the operculum, globular, smooth. The ancestrula is a small ordinary zooecium.

Measurements.—

Zooecium { Lz=0.55–0.65 mm. / lz=0.4–0.45 mm. } Opesium { ho=0.3–0.35 mm. / lo=0.2–0.25 mm. }

16 or 17 zooecia in 4 sq. mm.

Structure.—The zooecial structure of this species is exactly that of *Allantopora irregularis* Gabb and Horn, 1860, the same form, same gymnocyst, same spines, and same ovicell. The single difference is in the nature of the zoarium, which is multiserial and not uniserial. It is difficult to see in this slight difference a generic character. Almost all the recent uniserial species sometimes exhibit multiserial zoaria. The cells approaching each other become united and form an ensemble exactly like the colonies of other multiserial species. Dietellae, however, are never present, which is exactly the case here. Regenerated zooecia are abundant. There is often an eleventh spine on the proximal border of the termen.

Affinities.—We cannot class this species in *Pyrulella* Harmer, 1926, for in that genus the ovicell is closed by the opercular valve. *Callopora sexspinosa* Canu and Bassler, 1920, from the Midwayan of Alabama has an identical structure and should be placed in the same genus.

Occurrence.—Vincentown limesand: Vincentown, N.J. (rare).

Holotype and plesiotype.—U.S.N.M. No. 52600.

Genus PERIPOROSELLA Canu and Bassler, 1917

PERIPOROSELLA(?) PLEBEIA Gabb and Horn, 1862

PLATE 5, FIGURES 1–3

1862. *Membranipora plebeia* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 158, pl. 20, fig. 43.

1907. *Membranipora plebeia* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 334, pl. 23, fig. 17 (bibliography).

Description.—The zoarium is encrusting, growing upon shells, echinoids, and other Bryozoa. The zooecia are distinct, separated by a deep furrow, very elongated, oval, generally enlarged at the base; the mural rim is thin, rounded, with six pairs of hollow spines; the opesium is large, entire, of the same form as the zooecium. There are a distal septula and six lateral pairs opened widely at the bottom of the zooecium. The ovicell is hyperstomial, not closed by the operculum, small, globular, smooth. Above each zooecium there is an interzooecial avicularium arranged longitudinally, with its beak somewhat enlarged and oriented toward the base. The orifice is symmetrical and slightly narrowed toward the middle.

Measurements.—

Zooecium $\begin{cases} Lz = 0.48–0.57 \text{ mm.} \\ lz = 0.27–0.3 \text{ mm.} \end{cases}$ Opesium $\begin{cases} lo = 0.39–0.43 \text{ mm.} \\ lo = 0.18–0.21 \text{ mm.} \end{cases}$

25–28 zooecia is 4 sq. mm.

Variations.—The micrometric measurements vary from one zoarium to another; the largest figures that we give above appear to be the maximum. Rather rarely there is a very small gymnocyst below the opesium. Elliptical and nonpyriform cells are not rare. We have often observed regenerated zooecia.

The ordinary avicularia appear to be oriented toward the aperture of the proximal zooecium. On the contrary, the avicularia with gymnocyst and transformed into zooeciules always have their beak oriented distally.

The ovicells replace the avicularia. The latter are quite constant, and their position is always the same except when the irregularities of the substratum disarrange the gemmation. When they are absent between the nonovicelled zooecia, it is always easy to discover them on the interior of the distal zooecium. We have many times observed this curious phenomenon both on the fossil forms and on Recent specimens. It is inexplicable.

Gabb and Horn's figure, lacking the areal spines, is incomplete, but the interpretation of Ulrich and Bassler, 1907, is correct, all the other characters being identical. We are not certain that our generic reference is exactly correct. *Membranipora humiliata* Brydone, 1910, and *M. anterides* Brydone, 1910, both from the English Senonian, have an analogous structure.

Occurrence.—Vincentown limesand: Mullica Hill (Gabb and Horn), Vincentown and near Blackwoodstown, N.J. (common); Noxontown Millpond, Del.

Plesiotypes.—U.S.N.M. Nos. 73869–73871.

Genus CRASSIMARGINATELLA Canu, 1900

CRASSIMARGINATELLA INTERMEDIA, new species

PLATE 5, FIGURES 4–7

Description.—The zoarium encrusts fragments of shells and free Bryozoa. The zooecia are distinct, separated by a deep furrow, elliptical, elongated; the mural rim is thin distally and somewhat enlarged at the base; it is salient, flat interiorly, and finely granulated. The opesium is large, entire, of the same form as the zooecium, finely crenulated. The ovicell is hyperstomial, not closed by the operculum, globular, transverse, smooth, carinated, embedded in the distal zooecium. The interzooecial avicularium is large, sporadic, provided with a gymnocyst, primoserial, pyriform, terminating in the form of the beak of a duck; its opesium is large median, elliptical. The ancestrula is a small ordinary zooecium.

Measurements.—

Zooecium $\begin{cases} Lz = 0.54–0.66 \text{ mm.} \\ lz = 0.36–0.41 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.39–0.48 \text{ mm.} \\ lo = 0.23–0.37 \text{ mm.} \end{cases}$

24–28 zooecia in 4 sq. mm.

Variations.—The zooecia increase in size according to their distance from the ancestrula; our first measurements are those of the average zooecia, the second of the marginal ones.

The ovicells are quite typical; their orifice placed above the mural rim is easily visible on inclining the preparation slightly. When the proximal border of the ovicell covers the distal border of the mural rim, the observer may hesitate, but on dissection one can note that the distal border is neither attenuated nor deformed and that the opercular valve supported on it does not close the ovicell. The presence of the longitudinal carina is not constant.

Regenerated zooecia are abundant. Our figures present almost all the possible cases of total regeneration, notably: (1) An ordinary zooecium regenerated by an ordinary zooecium; (2) an ordinary zooecium regenerated by an ovicelled zooecium; (3) an ovicelled zooecium regenerated by an ordinary zooecium; and (4) an interzooecial avicularium regenerated by an ordinary zooecium. We have figured a case of cellular inversion appearing without any apparent reason.

The interzooecial avicularia are almost always primoserial, although they rarely appear in a longitudinal series already formed. They also serve as cells to fill in empty spaces in cases of irregularity in the gemmation. Their number on a given surface is very variable. They are indeed organs of adaptation whose presence is regulated only by the necessity of the moment. Their dimensions are variable and in harmony with those of adjacent zooecia.

177635—33——3

Affinities.—*Crassimarginatella* and *Valdemunitella* were created by Canu in 1900 as artificial subgenera in order to facilitate the determination of the Cretaceous Membranipores. The senior author feels that Norman, 1905, Harmer, 1926, and Hastings, 1930, have been in error in describing them as natural genera and that such interpretations should never be permitted by the rules of nomenclature. *Membranipora valdemunita* Hincks, 1880, and *M. crassimarginata* Hincks, 1880, having different ovicells, should not remain in the same genus *Oochilina*, created for them by Norman in 1903. The form of the avicularia cannot be considered as a generic character, because they are inconstant and are organs of adaptation. Thus *Crassimarginatella intermedia*, the present species studied, has ovicells as in *Crassimarginatella* and avicularia as in *Valdemunitella*.

In establishing new genera we cannot hold only that the simple presence of the avicularia indicates a function indispensable to the colony. It is necessary then to redefine these genera as follows:

Crassimarginatella: Ovicell hyperstomial, not closed by the operculum. Interzooecial avicularia sporadic.

Valdemunitella: Ovicell hyperstomial, closed by the operculum. Interzooecial avicularia sporadic.

Occurrence.—Vincentown limesand: Common at Vincentown and near Blackwoodstown, N.J.

Cotypes.—U.S.N.M. No. 73867.

CRASSIMARGINATELLA NEMATOPOROIDES Ulrich and Bassler, 1907

PLATE 6, FIGURES 1, 2

1907. *Membranipora nematoporoides* ULRICH and BASSLER, *in* Weller, Geol. Surv, New Jersey, Paleontology, vol. 4, p. 336, pl. 24, fig. 13.

Description.—The zoarium consists of narrow, subquadrangular or subcylindrical, dichotomous branches 0.6 to 0.7 mm in diameter, which are celluliferous on all sides, the zooecia being arranged in from 4 to 6 longitudinal rows. The zooecia are distinct, much elongated, oval; the proximal gymnocyst is convex, smooth, occupying about a quarter of the zooecial length; the mural rim is thick, elliptical, salient and bears 5 or 6 pairs of tubercles and some minute distal spines. The opesium is elliptical, regular, elongated, terminal. The ovicell is hyperstomial, not closed by the operculum. The interzooecial avicularium is beaklike, with a pivot; it is formed of two portions, the proximal portion, a small ordinary cell and the distal portion bearing a very salient unguiculate beak perpendicular to the zooecial plane.

Measurements.—

Zooecia { Lz=0.45−0.55 mm. lz=0.25−0.3 mm. Opesium { ho=0.3−0.35 mm. lo=0.15−0.17 mm.

Affinities.—It is difficult to class this species generically. Its remarkable avicularium is unique and characterizes it excellently. In spite of our views in the past, our new studies on the recent species no longer permit us to give too great importance to the avicularia in the general classification.

Occurrence.—Vincentown limesand: Vincentown, N.J. (rare).

Cotypes.—U.S.N.M. No. 52602.

Genus CALLOPORA Gray, 1848

CALLOPORA JERSEYENSIS Ulrich and Bassler, 1907

PLATE 6, FIGURES 7–10

1907. *Membranipora jerseyensis* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 336, pl. 24, fig. 3.

Description.—The zoarium is free, bifoliate, with broad fronds, flat or undulated. The zooecia are distinct, separated by the interopesial avicularian chambers, elongated, elliptical; the mural rim, visible only on the young zooecia, is thin, salient. The opesium is deep, elongated, elliptical. The ovicell is hyperstomial, not closed by the operculum, convex, smooth, marginated on its free proximal border. There are four pairs of avicularia usually around each opesium; they are adjacent to one another, elliptical with a pivot, diversely oriented.

Measurements.—

Zooecia { Lz = 0. 6–0. 9 mm. / lz = 0. 35–0. 45 mm. } Opesia { ho = 0. 42–0. 5 mm. / lo = 0.25–0.3 mm. }

14 zooecia in 4 sq. mm.

Structure.—This beautiful species is well characterized by its interopesial avicularia. They form a calcareous layer or epicalcification between the zooecial mural rims, which are quite separated from one another, as can be verified in the young zooecia. They are grouped principally around the opercular valve (that is, the distal part of the opesium) to the number of 4; 2 belong to the proximal zooecium and 2 to the distal zooecium. But the gemmation, often irregular, disarranges this order, and then each opesium appears simply surrounded by 8 avicularian chambers adjacent but distinct and separated by a shallow furrow. These adventitious avicularia are quite large, but even on well-preserved specimens it is hardly possible to observe their orientation because of their symmetry. If we suppose that their smaller orifice is placed at the slightly narrowed end, most of them are oriented toward the base (downward). In tangential sections they are seen to be interopesial. The primoserial avicularia are transverse.

This intense epicalcification is a perfectioning of the pores of calcification observed in the genus *Craspedopora* Canu and Bassler,

1929 (Eocene, Miocene), and *Collarina* Jullien, 1888 (Eocene). The simple pores have here become complete and very active avicularia.

It is impossible to obtain a transparent thin section of this species, as the calcareous elements in it are absolutely opaque. In transverse sections the median lamella is simple and the two zoarial lamellae are inseparable.

Occurrence.—Vincentown limesand: Vincentown, N. J. (not common).

Holotype and plesiotype.—U.S.N.M. No. 52661.

CALLOPORA NOXONTOWNENSIS, new species

PLATE 6, FIGURES 5, 6

Description.—The zoarium encrusts fragments of shells. The zooecia are distinct, separated by a deep furrow, elongated, oval, with a proximal gymnocyst covered by 1 or 2 avicularia; the mural rim is thick, enlarged at the base, decorated with 4 hollow apertural spines and granular. The opesium is oval, finely crenulated. The ovicell is hyperstomial, not closed by the operculum, globular, smooth. The avicularia are triangular, unoriented, oblique on the zooecial plane; the beak is pointed, very salient.

Measurements.—

Zooecia { *Lz* = 0.5–0.55 mm. / *lz* = 0.25–0.27 mm. } Opesium { *ho* = 0.27 mm. / *lo* = 0.12–0.15 mm. }

28 zooecia in 4 sq. mm.

Variations.—When the zooecia are not ovicelled there is generally but a single avicularium. It develops into two small avicularia above the ovicell.

The special characteristic of this species lies in its 4 hollow spines. The 2 distal spines are not placed on the mural rim but are always adjacent to it; the other 2 are on the mural rim but a little lower down, probably in the neighborhood of the articulation of the opercular valve; on the fertile zooecia they are adjacent to the ovicell; often one of them appears lacking, but on the fossils these small details disappear easily.

Occurrence.—Vincentown limesand: Noxontown Millpond, Del. (very rare).

Holotype.—U.S.N.M. No. 73882.

Genus AMPHIBLESTRUM Gray, 1848

AMPHIBLESTRUM (?) ABORTIVUM Gabb and Horn, 1862

PLATE 7, FIGURES 2–8

1862. *Flustrella capistrata* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 161, pl. 20, fig. 48.

1862. *Membranipora abortiva* Gabb and Horn, *Ibid.*, p. 157, pl. 20, fig. 41.
1907. *Flustrella capistrata* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 329, pl. 22, figs. 5, 6 (bibliography).

Description.—In *Membranipora abortiva* Gabb and Horn, the zoarium encrusts fragments of shells and other Bryozoa. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, with a short convex gymnocyst; the mural rim is salient, thin, smooth, bearing 1 or 2 pairs of spines; the cryptocyst is shallow, short, concave, enlarged at the base. The opesium is elongated, pyriform. The ovicell is hyperstomial, never closed by the operculum, globular, smooth or decorated with two crescents arranged symmetrically. There is an auriform vibraculum (?) in each angle of junction of the zooecia. The ancestrula is a small ordinary zooecium. The aborted zooecia are irregular, convex, smooth, deprived of mural rim, perforated by a small median orifice.

Measurements.—

Zooecia { Lz=0.3–0.4 mm. / lz=0.2 mm. } Opesium { ho=0.15–0.17 mm. / lo=0.12–0.14 mm. }

45 zooecia in 4 sq. mm.

Structure.—This is a curious and complicated species, the biology of which and the nature of the small intercellular organs are difficult to interpret. We believe the latter are auriform vibracula, although they have been interpreted previously as avicularia. The discovery of specimens with perfect preservation could only solve the question. Moreover, it would be only by the discovery of a basal side that we could learn whether they are interzooecial. They are arranged longitudinally, and their orifice is oblique with respect to the zooecial plane. Their presence is constant, and their absence occasions the regeneration of adjacent zooecia.

Each new zooecial series begins always with a vibraculum, but it is turned inversely to the adjacent vibracula. Because of the slight zooecial length it is placed just above the normal vibraculum dependent on the proximal zooecia and almost adjacent to the vibraculum of the distal zooecia. As a result each new zooecial series appears to commence with a small chain of three or four vibracula.

In the ancestrular region, the zooecia are deprived of interzooecial vibracula; those which form are always primoserial and consequently they do not have the chain formation mentioned above.

The specific character is the presence of the peculiar aborted cells. Without normal orifice they cannot contain a polypide. Without mural rim they have simply the aspect of calcareous vesicles variable in dimension and form. They are sporadic or in groups. They much interested Gabb and Horn, who described them as follows:

Between the cellules and without any regular arrangement, are placed, in most colonies, a large number of abortive cellules, of the same shape as the larger ones. In some colonies these abortive cells are full as numerous as the normal ones, and only in a very few instances have we observed colonies to be entirely without them. When the latter is the case, the normal cells are much more regular in size and in arrangement.

The zooecia are very active, this activity manifesting itself in the presence of numerous regenerated zooecia. But what is most extraordinary is to note normal zooecia regenerated by aborted zooecia. It is necessary then to conclude that the latter exercise an important function on the zoarium. We cannot consider them as true aborted zooecia but must believe them to be special cells with different function from that of the various kenozooecia that we know.

The structure of *Membranipora abortiva* is rather different from that figured by Gabb and Horn, 1862, but by reading their text attentively it can be shown that Ulrich and Bassler, 1907, were correct in their interpretation of the species.

Affinities.—In the nature of its ovicell, the presence of a cryptocyst, and the place of its avicularia, *Membranipora abortiva* ought to be classed in *Amphiblestrum*. However, if the presence of vibracula is confirmed, it would be necessary to create a new genus.

The recent species closest to it is *Antropora pustulata* Canu and Bassler, 1928, dredged in deep waters of the Gulf of Mexico, in which the ovicell is also hyperstomial and which presents the same kenozooecia (=aborted zooecia.) The fossil species differs, however, in the place and the nature of the avicularia, which are zooecial and acuminate. This relative identity of exterior aspect seems to confirm the suggestion made for another species that the Vincentown marls may be deposits of relatively deep water.

The genus *Antropora* Norman, 1903, has for its genotype *Membranipora granulifera* Hincks, 1880, from Madeira. Hincks did not figure the ovicell, and Norman, 1903, did not mention it but compares this genus with *Amphiblestrum*. Finally, Harmer refigured Hincks' species with specimens from Malaysia, in which he discovered an endozooecial ovicell and interzooecial (zoarial) avicularia. We believe that *Antropora* still requires restudy.

Herpetopora anglica Lang, 1914, from the English Senonian and *Mystriopora mockleri* Lang, 1915, from the English Cenomanian present the same aborted zooecia. These are uniserial species.

Many fossil and recent *Membranipora* frequently have calcified zooecia, which always replace ordinary zooecia. These must not be confused with the aborted zooecia studied here, which have neither regular form nor constant dimensions. Zoology is silent on the anatomy and physiology of all these heteromorphic zooecia, and the paleontologist cannot make useful comparisons.

In *Flustrella capistrata* Gabb and Horn, the zoarium is free, branching dichotomously, formed of 4 to 8 longitudinal rows of zooecia, prismatic, claviform or compressed. The zooecia are distinct, separated by a deep furrow, elongated, elliptical; the mural rim is salient, thin, smooth, without spines; the cryptocyst is shallow, short, concave, enlarged at the base. The opesium is elongated, pyriform. The ovicell is hyperstomial, never closed by the operculum, globular, smooth. There is an auriform vibraculum (?) in each angle of junction of the zooecia between them.

Zooecia $\begin{cases} Lz = 0.3\text{–}0.4 \text{ mm.} \\ lz = 0.2 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.15 \text{ mm.} \\ lo = 0.1 \text{ mm.} \end{cases}$

The zooecial structure is practically identical with that of *Amphiblestrum abortivum*, even to the smallest detail. There are, however, some small differences that should be noted, namely, the absence of gymnocyst, of aborted zooecia, and of small crescents on the ovicell, and opesium somewhat smaller. Ulrich and Bassler, 1907, considered *Flustrella capistrata* as the free form of *Amphiblestrum abortivum*, and the discovery of encrusting specimens with free expansions arising from them proves the identity of the two.

Occurrence.—Vincentown limesand: Timber Creek, near Mullica Hill (Gabb and Horn); both the incrusting form and the free branches are not uncommon at Vincentown and near Blackwoodstown, N.J.

Plesiotypes.—U.S.N.M. Nos. 73880, 73881.

Genus EURITINA Canu, 1900

EURITINA TORTA Gabb and Horn, 1862

Plate 6, Figures 3, 4

1862. *Biflustra torta* Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 152, pl. 20, fig. 36.

1907. *Biflustra torta* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 331, pl. 23, figs. 11, 12 (bibliography).

1920. *Euritina torta* Canu and Bassler, U.S.Nat. Mus. Bull. 106, p. 257, pl. 5, fig. 16 (bibliography).

Description.—The zoarium is free, bilamellar, formed of undulated fronds, narrow or wide. The zooecia are distinct, separated by their adjacent mural rims, very elongated, subrectangular; the mural rim is thin, salient; the cryptocyst is deep, smooth, oblique, with three distinct faces; the opesium is terminal, elliptical, regular. The onychocellaria are fusiform, acuminated distally, generally primoserial; the cryptocyst is shallow, flat, smooth. The ovicell is hyperstomial, cucullate, semiglobular with proximal border fringed and carinated longitudinally; the posterior margin of the domelike covering extends backward to the anterior margin of the zooecial aperture just behind.

Measurements.—

Zooecia { *Lz* = 0.54 mm. / *lz* = 0.27–0.36 mm. Opesium { *ho* = 0.29–0.32 mm. / *lo* = 0.16–0.18 mm.

Onychocellarium { *Lon* = 0.45 mm. / *lon* = 0.27 mm. Opesium of onychocellarium { *hop* = 0.18 mm. / *lop* = 0.09 mm.

33 zooecia in 4 sq. mm.

Structure.—The distal border of the mural rim of the ovicelled zooecia is attenuated; moreover, it is much covered over by the ovicell; the opercular valve therefore closes the latter in opening and remains in a position perpendicular to the zooecial plane. This is a frequent case in the Membranipores, especially in *Membranipora valdemunita* Hincks, 1880.

Occurrence.—Vincentown limesand: Timber Creek and near Mullica Hill (Gabb and Horn), Vincentown and near Blackwoodstown, N.J. (common). Aquia formation (Eocene): Upper Marlboro, Md. (Ulrich and Bassler).

Plesiotype.—U.S.N.M. No. 52587.

Family OPESIULIDAE Jullien, 1888

Genus FLORIDINA Jullien, 1881

FLORIDINA SUBSCUTATA, new species

PLATE 7, FIGURE 1

Description.—The zoarium encrusts shell fragments. The zooecia are distinct, more or less elongated, and sometimes transverse, small, ogival; the mural rim is thin, little salient; the cryptocyst is shallow, slightly convex, smooth. The opesium is trifoliate, transverse, with proximal border very convex; the opesiular indentations are large and rounded. Onychocellaria present. Ovicell and ancestrula unknown.

Measurements.—

Zooecia { *Lz* = 0.4 mm. / *lz* = 0.3 mm. Opesium { *ho* = 0.11 mm. / *lo* = 0.14 mm.

32 zooecia in 4 sq. mm.

Affinities.—In the genus *Floridina*, the zooecia have quite variable micrometric dimensions; not one resembles its neighbor, and certain dimensions vary up to twice the usual size. Those we give are the average taken on the most frequent forms. Our specimen bore only an incomplete onychocellarium.

The relationships of this species are with *Floridina* (*Membranipora*) *scutata* Levinsen, 1925, of the Danian of Faxe. We do not identify the two species as the same, because the Danish author did

not note the onychocellarium. Our specific name recalls the close specific affinity.

The genus *Floridina* still exists in the equatorial zone, and species are found in the American and European Tertiary. It made its appearance in Europe in the Senonian; it is well represented in the Maastrichtian and the Danian.

Occurrence.—Vincentown limesand: Noxontown Millpond, Del. (very rare).

Holotype.—U.S.N.M. No. 73885.

Genus MICROPORA Gray, 1848

MICROPORA OGIVALINA, new species

PLATE 8, FIGURE 8

Description.—The zoarium encrusts other Bryozoa. The zooecia are distinct, united by their mural rim, little or not elongated, ogival; the mural rim is thin, salient, finely granular; the cryptocyst is large, shallow, almost flat, finely perforated and granulated. The aperture is small, terminal, semielliptical, transverse. The opesiules are linear, short, adjacent to the mural rim, placed above the transverse axis of the zooecia. The apertural avicularium is small, oval, with a pivot, oriented obliquely, the beak at the top. The ovicell is endozooecial, large, convex, smooth.

Measurements.—

Zooecia { Lz=0.45–0.54 mm. / lz=0.36–0.45 mm. } Apertura { ha=0.04–0.05 mm. / la=0.12 mm. }

21 zooecia in 4 sq. mm.

Affinities.—The zooecial width is quite variable, this being one of the characteristics of the genus. This is a typical *Micropora* very close to the genotype *Micropora coriacea* Esper, from which it differs only in the micrometric measurements.

Occurrence.—Vincentown limesand: Very rare at Vincentown, N.J., and Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73891.

MICROPORA PARVA, new species

PLATE 8, FIGURE 4

Description.—The zoarium encrusts the debris of shells. The zooecia are distinct, united by their mural rims, elongated, oval; the mural rim is very thin, salient; the cryptocyst is shallow, flat, finely perforated; the opesiules are linear, more or less long, adjacent to the mural rim. The aperture is small, terminal, semielliptical,

transverse, with very thin peristome. The apertural avicularium is triangular, with a pivot, with salient and pointed beak, and oriented obliquely. Ovicell and ancestrula unknown.

Measurements.—

Zooecia { *Lz*=0.4–0.5 mm. *lz*=0.25–0.3 mm. Apertura { *ha*=0.05 mm. *la*=0.1 mm.

29 zooecia in 4 sq. mm.

Affinities.—This is another typical species quite close to the genotype. It differs from *Micropora ogivalina* in its smaller dimensions, its longer opesiules, and its triangular avicularium.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73893.

MICROPORA (?) CYLINDRACEA Ulrich and Bassler, 1907

PLATE 8, FIGURE 6

1907. *Micropora cylindracea* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 347, pl. 25, fig. 4.

The description of 1907 is correct. No additional specimens have been discovered, and we continue in ignorance of the ovicell and the base.

Occurrence.—Vincentown limesand: Vincentown, N.J. (very rare).

Holotype.—U.S.N.M. No. 52604.

MICROPORA(?) PULCHRA Ulrich and Bassler, 1907

PLATE 8, FIGURE 5

?1886. *Vincularia sculpta* (?D'ORBIGNY) PERGENS and MEUNIER, Ann. Soc. Malacol. Belge, vol. 21, p. 49 (fide Voigt).

?1892. *Steganoporella sculpta* (?D'ORBIGNY) HENNIG, Lunds Univ. Ärsskr., vol. 28, p. 35, pl. 1, fig. 20 (fide Voigt).

1907. *Micropora pulchra* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 347, pl. 25, fig. 3.

1930. *Micropora* cf. *pulchra* VOIGT, Leopoldina, vol. 6, p. 476, pl. 24, fig. 20.

Description.—The zoarium is free, bilamellar; the fronds are narrow, dichotomous. The zooecia are distinct, separated by a deep furrow, much elongated, quite narrow, subcylindrical, sinuous; the mural rim is thick, salient, rounded; the cryptocyst is shallow, slightly convex, finely perforated, without opesiules. The aperture is terminal, semielliptical, transverse, with a proximal concave lip independent of the mural rim. The ovicell is endozooecial, very small, convex, smooth. The apertural avicularium is very small, triangular, with pivot, with beak oriented perpendicularly to the zooecial plane.

Measurements.—

Zooecia { *Lz*=0.9–1 mm. *lz*=0.25–0.3 mm. Apertura { *ha*=0.12–0.15 mm. *la*=0.15–0.17 mm.

Affinities.—In spite of the presence of an endozooecial ovicell and of an apertural avicularium this species is not a *Micropora;* it differs in the absence of the opesiules and in the structure of the aperture, where the proximal lip looks like a polypidian lamella.

This peculiarity did not escape Pergens and Meunier in 1886, who noted on the European specimens an aperture having the form of that in *Steganoporella.* This structure is quite visible on certain cells, but unfortunately it is not very constant. However, the proximal lip is always independent and is never formed by a transverse trabecula attached to the mural rim and placed at its level. It will be necessary to find a similar structure in the genus *Crateropora* or *Labiopora.* But these have ovicells of a very different nature and are deprived of adventitious avicularia. It is then with just reason that Voigt, 1930, made this species the type of a special group of *Micropora.* He correctly places here *Cellepora subgranulata* Hagenow, 1851, from the Maastrichtian of Limbourg. Unfortunately he gave no explanation, and his figures are very poor. This is certainly a new genus peculiar to the Upper Cretaceous, but for the want of material we are unable to fix all the characters from sections and dissected specimens.

The European specimens have been compared to *Vincularia sculpta* D'Orbigny, 1852, from the French Senonian. The latter with its six opesiules probably belongs to the genus *Puncturiella* Levinsen, 1925.

The bibliography given by Voigt, 1930, for the European specimens is absolutely correct, but we think they belong to a different species in which the cells are much smaller (0.6 mm and not 1 mm).

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 52605.

Family ASPIDOSTOMIDAE Jullien, 1888

Genus MOLLIA Lamouroux, 1821

MOLLIA LACESSITOR, new species

PLATE 7, FIGURE 9

Description.—The zoarium encrusts fragments of shells, Serpulae, and other Bryozoa, often over large surfaces. The zooecia are distinct, separated by a deep furrow, little elongated, hexagonal; the mural rim is thin, little salient; the cryptocyst is large, shallow, somewhat convex at the base and slightly concave in front of the opesium. The opesium is terminal, transverse, somewhat trifoliate, with an

almost straight proximal border. The ovicell is hyperstomial, deeply embedded in the distal zooecium, closed by the operculum, large, globular, smooth.

Measurements.—

Zooecia { *Lz*=0.5 mm. / *lz*=0.35–0.45 mm. Opesium { *ho*=0.12 mm. / *lo*=0.15–0.2 mm.

25 or 26 zooecia in 4 sq. mm.

Structure.—As the distal border of the mural rim is not visible under the ovicell, one might believe that the latter is endozooecial, but by dissection its true nature is easily seen.

The zoarium is very vigorous. It entirely surrounds other Bryozoa and hides its true nature. It attaches itself also to young living Serpulae, which are obliged to widen their spires in order to develop. This is a kind of aggressive commensalism, similar to that which Lecointre, 1929, has noted in the gastropods.

The opesia of the ovicelled zooecia are larger than the others.

Affinities.—This species differs from *Mollia deshayesi* Hagenow, 1851, from the Maastrichtian of Limbourg in its somewhat more elongated cells and in the absence of the disjunction between the zooecia.

Occurrence.—Vincentown limesand: Vincentown, N.J. (rare).

Cotypes.—U.S.N.M. No. 73883.

MOLLIA PARVICELLA, new species

PLATE 7, FIGURE 10

Description.—The zoarium encrusts shell fragments. The zooecia are distinct, separated by a deep furrow, small, somewhat elongated, elliptical; the mural rim is thin, rounded, little salient; the cryptocyst is large, smooth, shallow, convex. The opesium is terminal, trifoliate, transverse, with a proximal border slightly convex. The ovicell is hyperstomial, salient, convex, transverse, smooth.

Measurements.—

Zooecia { *Lz*=0.35 mm. / *lz*=0.25–0.3 mm. Opesium { *ho*=0.1–0.12 mm. / *lo*=0.15 mm.

37 zooecia in 4 sq. mm.

Affinities.—We have observed only 2 specimens of this small species, one of which bears some calcified opesia.

There is a large distal septula and perhaps distal dietellae are present. The species differs from *Mollia lacessitor*, new species, in its small zooecial dimensions.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond and 2 miles southwest of Odessa, Del.

Holotype.—U.S.N.M. No. 73884.

Genus MONOPORELLA Hincks, 1881

MONOPORELLA (?) LATICELLA, new species

PLATE 8, FIGURE 1

Description.—The zoarium encrusts shell fragments. The zooecia are distinct, separated by a salient thread, large, hexagonal, little elongated; the frontal is smooth, convex, and bears two large opesiules placed above the transverse axis of the zooecium and removed from the separating thread. The aperture is terminal, small subcircular or transversely subelliptical in outline, the posterior margin usually truncated, bordered by a rather thick, moderately elevated rim feebly indented laterally. Ovicell and ancestrula unknown.

Measurements.—

Zooecia $\begin{cases} Lz = 0.8 \text{ mm.} \\ lz = 0.75 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.1 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

11 or 12 zooecia in 4 sq. mm.

Affinities.—Because of its olocystal frontal, this species cannot be classed in *Micropora*, *Monoporella*, or *Macropora*. In its exterior aspect, in the form of the apertura, and in the size of the zooecia it appears to be related to *Monoporella*, that is, to the Aspidostomidae.

The opesiules are rarely visible; almost always they disappear in fossilization, and they have escaped previous observers.

Micropora glabra Voigt, 1924, from the Upper Senonian of Germany has a structure absolutely identical and should later be classed in the same genus. The ovicell here is also unknown.

Voigt, 1930, has outlined this new genus in creating the *Micropora erecta* group. Unfortunately, this group lacks homogeneity, for no opesiules have been noted on certain species, especially *Cellepora erecta* Hagenow, 1846.

Occurrence.—Vincentown limesand: Vincentown, N.J. (rare).

Holotype.—U.S.N.M. No. 74466.

MONOPORELLA(?) VINCENTOWNENSIS Ulrich and Bassler, 1907

PLATE 20, FIGURES 4–7

1907. *Micropora*(?) *vincentownensis* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 348, pl. 25, fig. 9.

Description.—The zoarium encrusts the debris of shells, but principally *Coscinopleura digitata*. The zooecia are distinct, separated by a thin thread located at the bottom of a furrow, hexagonal, elongated; the frontal is convex, smooth, perforated by 2 small opesiules, often covered with a tuberous pellicle, frequently ornamented with two transverse lamellar expansions, placed between 2 apertures. The apertura is semielliptical, transverse; the proximal border is linear,

with two very small lateral indentations; the peristome is thick, salient, and bears two distal hollow spines. The ovicell is a salient, cylindrical, transverse pad, hyperstomial, placed on the distal zooecium.

Measurements.—

Apertura { *ha*=0.07 mm. / *la*=0.13 mm. } Zooecia { *Lz*=0.57 mm. / *lz*=0.5–0.54 mm. }

Ovicell { *hov*=0.21 mm. / *lov*=0.54 mm. }

Variations.—The aliform expansions of the frontal are characteristic but quite sporadic; at Vincentown they are rare, although they are more frequent at Blackwoodstown. They mark certainly the place of the ovicell, but it is impossible to determine whether they are young ovicells in process of formation or old broken ovicells.

The two distal spines are rarely visible, but they appear on the better-preserved specimens. Rarer still are the opesiules. They are almost always closed by fossilization and appear only in the very special conditions of preservation.

The recognition of the exact structure of fossil species is often difficult because of the alterations that they undergo under the more diverse influences. Subsequent calcification by infiltration of superficial waters is the great enemy of the paleontologist, for it penetrates all the small pores and forms secondary ornamentations, often difficult to differentiate from the primitive structure. This is frequently the case in *Monoporella.*

Affinities.—*Monoporella vincentownensis* differs from *M. laticella*, new species, in the much smaller micrometric dimensions and in the presence of lamellar frontal expansions.

Occurrence.—Vincentown limesand: Rather rare at Vincentown and near Blackwoodstown, N.J.

Holotype and plesiotypes.—U.S.N.M. No. 52606.

Genus RHAGASOSTOMA Koschinsky, 1885

RHAGASOSTOMA AMERICANA, new species

PLATE 8, FIGURE 7

Description.—The zoarium encrusts the debris of shells. The zooecia are distinct, elongated, hexagonal; the mural rim is thick, salient, granular; the cryptocyst is deep, large, flat, smooth. The opesium is semielliptical, terminal, transverse, with proximal border somewhat convex; the opesiular indentations are small, sublinear, very short, divergent. The ovicell is hyperstomial, not closed by the operculum, globular. The onychocellarium is primoserial, much elongated, fusiform, with rounded beak; the opesium is elliptical,

much elongated, median. The ancestrula is a small ordinary zooecium.

Measurements.—

Zooecium $\begin{cases} Lz = 0.5 \text{ mm.} \\ lz = 0.4 \text{ mm.} \end{cases}$ Opesium $\begin{cases} ho = 0.12 \text{ mm.} \\ lo = 0.15 \text{ mm.} \end{cases}$

26 zooecia in 4 sq. mm.

Affinities.—Our specimens are fragmentary, and we figure the best example to indicate the presence of the genus in American strata, where it previously had not been found, even though it is abundant in the European Cretaceous.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73904.

Family SETOSELLIDAE Levinsen, 1909

SETOSINELLA, new genus

The ovicell is cassiform,[8] hyperstomial, not closed by the operculum. The proximal border of the aperture is limited by a transverse, salient trabecula attached to the mural rim (as in *Micropora*). The cryptocyst is bounded entirely by the mural rim and bears two lateral opesiules. In each interzooecial angle there is a setiferous avicularium.

Genotype.—*Setosinella prolifica*, new species.

In this genus the zooecial structure is exactly that of *Micropora*, but the ovicell is hyperstomial and is not closed by the operculum as in *Setosella*. It appears to us to be cassiform, that is, not placed on the cryptocyst of the distal zooecium and as interzooecial.

SETOSINELLA PROLIFICA, new species

PLATE 9, FIGURES 7, 8

Description.—The zoarium encrusts fragments of shells and other Bryozoa. The zooecia are distinct, separated by a deep furrow, oval, swollen, little elongated; the mural rim is thin, salient; the cryptocyst is deep, smooth, flat, subcircular, entirely surrounded by the mural rim and by the transverse trabecula. The aperture is terminal, semicircular; the peristome is salient and adorned with four hollow spines. On the peristome of many of the zooecia is a distal thickening perforated by a pore or by a transverse slit.

The ovicell is hyperstomial, not closed by the operculum, globular, smooth, and occurring frequently. The avicularia are placed in the interzooecial angles; they are long, very thin, with two denticles for

[8] In this type of ovicell, the length is added to the zooecial length in measurements.

a pivot; the beak is truncated, and the distal canalicule is open to allow the passage of the long mandibular seta. The ancestrula is a very small ordinary zooecium, the peristome of which bears only two small solid spines.

Measurements.—

Zooecia { Lz=0.5 mm, lz=0.3 mm } (including ovicell). Apertura { ha=0.09 mm., la=0.08 mm.

33 zooecia in 4 sq. mm.

Structure.—This species has the appearance of a *Setosella*, but there are the important differences that the ovicell is not closed by the operculum and the vibracula are replaced by the setiferous avicularia. The presence of the long mandibular seta is unquestionable, as it is well proved by the truncated beak, which makes it possible for the seta to emerge from the small distal canalicule. We have always thought that such avicularia are tactile organs. Here when the mandibular seta is completely open and pressed down, it touches the operculum of the distal zooecium. The function of the small perforated distal kenozooecium that surmounts many of the zooecia is unknown.

We have not observed true perforating opesiules; the place of some of these is, however, sufficiently indicated to prove that they must occur. They must have been very small, which explains their disappearance in fossilization.

The larvae must have been small and fragile and able only to fix themselves with great difficulty. In spite of the great abundance of ovicells, the species is in fact very rare.

Without the ovicell, the zooecia measure only 0.35 to 0.4 mm in length.

Occurrence.—Vincentown limesand: Vincentown, N.J. (rare).

Holotype.—U.S.N.M. No. 73903.

Family COSCINOPLEURIDAE Canu, 1913

Genus COSCINOPLEURA Marsson, 1887

COSCINOPLEURA DIGITATA Morton, 1834

PLATE 9, FIGURES 1–6

1834. *Eschara digitata* MORTON, Synopsis of the organic remains of the Cretaceous group of the United States, p. 79, pl. 13, fig. 8.

1920. *Coscinopleura digitata* CANU and BASSLER, U.S.Nat.Mus.Bull. 106, p. 275, pl. 2, figs. 7–22 (bibliography).

Description.—The zoarium is free, bilamellar; the fronds are narrow, dichotomously dividing on the same plane and forming a flabelliform ensemble. The zoaria are distinct, separated by a deep furrow, elongated, ogival in front, truncated behind, without mural

rim; the cryptocyst completely surrounds the opesium; it is deep, smooth, convex, more developed proximally. The opesium is anterior, semielliptical, little elongated, bordered with a thin salient peristome; the proximal lip is more thickened and bears two small opesiular indentations. The ovicell is recumbent, convex, smooth, terminated laterally by two symmetrically arranged horns. The opesium of the ovicelled zooecia is larger, transverse, semielliptical. The zooecial vibracula are placed on the zoarial margin; their frontal, perforated by large pores, is convex and terminated by a salient, oblique mucron partially covering the semicircular opesium. An epizooecial calcification frequently transforms groups of ordinary zooecia into kenozooecia, which are perforated simply by a median pore.

Measurements.—

$$\text{Zooecia}\begin{cases} Lz = 0.55\text{–}0.6 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases} \qquad \text{Opesium}\begin{cases} ho = 0.12\text{–}0.15 \text{ mm.} \\ lo = \begin{cases} 0.12 \text{ mm (ordinary).} \\ 0.2 \text{ mm (ovicelled).} \end{cases} \end{cases}$$

25 cells in 4 sq. mm.

Structure.—The genus *Coscinopleura* Marsson, 1887, in Europe is found only in the Upper Cretaceous, but in America, where conditions were apparently more favorable, it continues to the base of the Eocene. We refer the reader to our study of it in 1920 [9] for detailed description.

The structure of the vibracular cells is analogous to that of the vibracula characterizing the Recent family Selenariidae. These are powerful organs whose function has not yet been elucidated. They are always placed on the zoarial margin and often at the bifurcation of two branches. They exercise therefore a zoarial function and are apparently useless in zooecial life.

The epizooecial calcification, which transforms ordinary zooecia into kenozooecia at the base of many branches, is an extraordinary phenomenon. The process of their formation is always identical. A perforated calcareous lamella begins by closing the opesium of a zooecium; next the cryptocyst is covered and becomes indistinct. Finally, the calcification growing more intense, the zooecium becomes convex and assumes the most diverse polygonal forms. The kenozooecia are not always basal. They exist frequently even on the edge of the fronds, where they accompany or even replace the vibracula.

In 1920 we advanced the hypothesis that these zooecia could be hydrostatic, an opinion that has never been criticized but that no longer appears to us to be justified. In marine waters, in reality the

[9] U.S.Nat.Mus.Bull. 106, p. 275, 1920.

colonies do not have real weight when covered by their ectocyst. Moreover, all the integument contained in a cell having the density of water, their absence or presence could not have any hydrostatic consequences.

Another more plausible explanation is therefore in order. This zooecial epicalcification is more a means of reinforcement and consolidation, operating in places where a zoarial rupture would occur under certain conditions. In fact, in all the Tertiary or Recent Escharian Bryozoa, this epicalcification can be observed at the base of all the zoaria as noted by Milne Edwards as long ago as 1838.

Among our fossils we have found only fragments of fronds often bifurcated and always without a base. We have not been able to reconstruct the entire colony from these fragments, but it must have been large (probably many centimeters in height), flat, and more or less regularly flabellate. Such an ensemble would be fragile, and the lateral kenozooecia assuring solidity by a thicker calcification than the frontal and basal kenozooecia would avoid rupture at the dangerous points.

In 1920 we offered another hypothesis, suggested by the presence of the vibracula of the Selenariidae. We thought that the colonies of *Coscincopleura digitata* were more or less floating and attached to algae. Now that we think the Vincentown marl was accumulated at a considerable depth of water where marine waves have little effect, we consider this opinion no nearer the truth than the first.

The fragments of this species occur in innumerable quantities in most of the localities studied, but nevertheless the ovicells are relatively rare. The larvae, apparently not being delicate, easily and rapidly discovered the substratum necessary for their development. Moreover, the colonies must have been very large, as a single larva could give rise to a great number of fragments. An analogous phenomenon can be observed in the Recent seas with *Myriozoum truncatum* Pallas, 1766, in which a single larva gives rise to a bushy colony 8 centimeters in height and of the same width. After death such a colony can furnish hundreds of fragments such as those discovered in the Miocene formations, where the species is very abundant.

In general, this observation, which can apply to many other Recent species, makes it possible to establish the principle that zoarial fragments with very few ovicells always belong to large colonies. In the Cyclostomata, this observation also holds true, and it complicates the task of the paleontologist, who is thus frequently deprived of the essential characters for classification and determination.

In the Recent seas, large colonies after their death serve immediately as a substratum for a throng of other encrusting Bryozoa.

It is the same with *Coscinopleura digitata*, for on its innumerable fragments we have discovered for the greater part the encrusting species herein described. However, as the incrustation is never very thick, we must conclude that the sedimentation was rapid and that all these fragments were rapidly covered and fossilized.

Occurrence.—Vincentown limesand: Timber Creek, Mullica Hill (Gabb and Horn), Vincentown, and near Blackwoodstown, N.J. (very common).

Geological distribution.—Bryozoan beds of Aquia formation (Eocene): Upper Marlboro, Md.

Plesiotypes.—U.S.N.M. Nos. 63786, 73934.

Suborder ASCOPHORA Levinsen

Family LAGYNOPORIDAE Lang, 1916

Genus LAGYNOPORA Lang, 1916

LAGYNOPORA AMERICANA, new species

PLATE 10, FIGURE 6

Description.—The zoarium encrusts fragments of shells. The zooecia are distinct, separated by a deep furrow, elliptical, much elongated and quite convex; the frontal bears 6 or 7 pairs of flat, smooth, scattered costules joined together only on the median longitudinal axis; the apertural bar is thick, convex, and bears rarely a small median process. The aperture (visible exteriorly) is semi-elliptical, transverse, irregular; the distal peristome is thin, little salient, and bears two large hollow lateral spines. The ovicell is hyperstomial, buried in the distal zooecium not closed by the operculum, globular, smooth; its orifice is placed below the level of the apertural bar so that the operculum moves in a locella. Avicularia (?) sporadic and very rare. No dietellae.

Measurements.—

Zooecia $\begin{cases} Lz = 0.65 \text{ mm.} \\ lz = 0.35 \text{ mm.} \end{cases}$ Apertura (exterior) $\begin{cases} ha = 0.07 \text{ mm.} \\ la = 0.15 \text{ mm.} \end{cases}$

25 zooecia in 4 sq. mm.

Structure.—The structure is that of *Membraniporella*, and it is easy to restore the chitinous organs that have disappeared through fossilization. The arrangement of the orifice of the ovicell is significant; it is not placed above the convex apertural bar but below it; the opercular valve, not being able to pass beyond the latter, moves therefore under it in a kind of locella. Moreover, as it is necessarily attached to the ectocyst, the latter can be situated only under the frontal costules in the interior itself of the zooecium. The costules therefore belong to the kind we have termed pericystic. This is a

simple Membranipore in which the spicules are joined along the median axis above the ectocyst.

The orifice of the zooecium is not a real aperture, since it is at some distance and independent of the opercular valve. It is not, moreover, an opesium, since the latter is located beneath the costules and is not visible. In order not to add a new word to the nomenclature, we have simply called it the external aperture, since the tentacles must necessarily pass through it.

Lang, 1921, has explained very well the development of the median process of the apertural bar. On certain species it fuses with the proximal pair of apertural spines to form a shield above the proximal portion of the external aperture. In *Lagynopora americana*, it is rarely developed and visible.

We have not been able to determine the nature of the small interzooecial heterozooecia; they are very rare.

Our micrometric measurements are those of the largest zooecia observed on the two specimens in the National Museum collection.

Affinities.—The three genera of Lang, 1916, *Lagynopora*, *Hexacanthopora*, and *Prodromopora*, differ from one another only in the number of apertural spines and in the separation of the costules. These characters, not corresponding to distinct variations of a physiologic function, are not of generic value in our opinion, and these genera should be united under the name of *Lagynopora*. No species of this genus has been noted in the upper Danian either in Europe or in America.

Lang, 1921, has well described the calcified structure of the genus, but he has not deduced the general structure without which a natural classification is impossible.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73900.

Family ANDRIOPORIDAE Lang, 1916

Genus AEOLOPORA Lang, 1916

AEOLOPORA GRANDIS, new species

PLATE 10, FIGURES 1–3

Description.—The zoarium is encrusting. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, swollen, relatively *large;* the frontal is very convex and formed by 8 or 9 pairs of regular costules not joined to one another and by an orbicular central area of fusion surrounded by a ring of beads; the apertural bar is thick, convex, and forms an arch placed in front of the orifice of the ovicell. The aperture is indistinct, transverse, oblique,

elliptical; the distal border of the peristome is thick and bears spines. The ovicell is hyperstomial, buried in the distal zooecium, not closed by the operculum. Some avicularia, often primoserial, are irregularly placed between the zooecia. The ancestrula is a small ordinary zooecium or an ancestrular one.

Measurements.—

Zooecium { Lz=0.45–0.5 mm. lz=0.35 mm. } Apertura (exterior) { ha=0.07 mm. la=0.1 mm. }

6 or 7 zooecia in 1 sq. mm.

Structure.—The arched arrangement of the apertural bar in front and at the level of the orifice of the ovicell indicates clearly that the opercular valve operated below these two organs and had no relation with the exterior. Under these conditions the true ectocyst was placed under the frontal in which the spines form thus a pericyst. This is exactly the structure we have noted in *Lagynopora americana*. It is very different from that of *Distanseschar ella* and *Pliophloea*, in which the ectocyst surrounds the frontal. These differences are so fundamental that we cannot recognize the family Andrioporidae with the characters given by Lang in 1921.

Lang considered that the granules which limited the central area of fusion are the upturned original distal ends of the costae.

This is the largest of the known species of the genus. The avicularia are triangular, with or without a pivot; the beak is very salient in front of the zooecial plane.

Occurrence.—Vincentown limesand: Very rare near Blackwoodstown and at Vincentown, N.J.

Cotypes.—U.S.N.M. No. 73898.

Genus DISTANSESCHARELLA D'Orbigny, 1852

DISTANSESCHARELLA PUMILA Gabb and Horn, 1862

PLATE 10, FIGURES 4–5

1862. *Cellepora pumila* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 126, pl. 19, fig. 8.

1907. *Mucronella pumila* (part) ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 355, pl. 26, fig. 17 (not 16) (bibliography).

Description.—The zoarium encrusts *Coscinopleura* or the debris of shells. The zooecia are distinct, separated by a deep furrow, very small, elongated, somewhat fusiform; the frontal is convex, smooth, glossy, bordered with minute tubercles; the costules are numerous, delicate, closely joined together, and have a longitudinal keel. The aperture is small, terminal; two small cardelles, placed very low, separate a large semicircular anter from a small rectilinear poster; the peristome is thick, complete, salient, the apertural bar being

united to the distal portion. The ovicell is hyperstomial, closed by the operculum, embedded in the distal zooecium, globular, smooth. Thin zooeciules terminated by an elliptical orifice, often primoserial, appear frequently between the zooecia.

Measurements.—

Zooecia { *Lz*=0.35 mm. / *lz*=0.17 mm. } Apertura { *ha*=0.05 mm. / *la*=0.05 mm. }

Zooeciules, 0.2 mm long.

12 zooecia in 1 sq. mm.

Structure.—It is difficult to study this species, and it is necessary to calcine it or color the zoarium in order to tone down its glossy appearance. The usual magnification is too small to permit of minute details, which usually disappear in the process of halftoning.

The zooeciules are not avicularia, as Lang in 1921 believed. They have the appearance of nanozooids of the cyclostomatous Bryozoa so well described by Borg in 1928, which we have discovered in many Recent cheilostomatous genera.

Affinities.—It is difficult to distinguish between Lang's genera, *Nannopora*, *Tricolopora*, *Trilophopora*, and *Distanseschar ella* D'Orbigny, 1852, because of the insignificance of the characters employed. We have adopted the oldest of these names.

Occurrence.—Vincentown limesand: Timber Creek, Vincentown, and near Blackwoodstown, N.J. (rare).

Plesiotype.—U.S.N.M. No. 73928.

DISTANSESCHARELLA LATA, new species

PLATE 10, FIGURE 7

Description.—The zoarium encrusts *Coscinopleura* and fragments of shells. The zooecia are distinct, separated by a deep furrow, elongated, almost fusiform, wide; the frontal is convex and formed of four pairs of wide costules, flat, smooth, close together, little distinct and placed below a wide apertural bar. The apertura is small, somewhat elongated, semielliptical, terminal, with two minute cardelles placed below and a straight proximal border. The ovicell is hyperstomial, closed by the operculum, placed on the distal zooecium, globular, smooth. The zooeciules, isolated or grouped, are narrow, fusiform, and terminated by a small elliptical orifice.

Measurements.—

Zooecia { *Lz*=0.35–0.4 mm. / *lz*=0.22–0.25 mm. } Apertura { *ha*=0.05 mm. / *la*=0.03 mm. }

Zooeciules, 0.15–0.2 mm long.

8 zooecia in 1 sq. mm.

Affinities.—There are probably apertural spines. We have not observed the dietellae.

The species differs from *Distanscscharella pumila* Gabb and Horn, 1862, in its slightly larger micrometric dimensions (especially in width), in the absence of frontal tuberosities, and in the wider, less numerous, and more scattered costules. It is, moreover, the largest species of this group characterized by very small zooecia. There are no fundamental differences from Gabb and Horn's species, the same aperture, the same ovicell, and the same zooeciules.

In this group the aperture constant in form and dimensions was necessarily closed by an opercular valve opening exteriorly, chitinous and articulating on the two cardelles. Since the valve is attached to the ectocyst, the latter covers the frontal as in the greater part of the Recent Cribrimorphs. It has therefore a general structure much more evolved and complicated than that of *Lagynopora* previously studied.

Occurrence.—Vincentown limesand: Vincentown, N.J., and Noxontown Millpond, Del. (very rare).

Holotype.—U.S.N.M. No. 73297.

Genus PLIOPHLOEA Gabb and Horn, 1862

PLIOPHLOEA SAGENA Morton, 1834

PLATE 11, FIGURES 1–5

1834. *Flustra sagena* MORTON, Synopsis of the organic remains of the Cretaceous group of the United States, p. 79, pl. 13, fig. 7.

1921. *Pliophloea sagena* LANG, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 3, pt. 1, p. 189, text fig. 89, pl. 6, fig. 4 (bibliography).

Description.—The zoarium is free, multilamellar; the first lamellae are placed back to back and inseparable. The fronds are more or less broad, compressed, flat or undulated, bifurcated in the same plane. The zooecia are distinct, separated by a deep furrow, much elongated, elliptical or oval; the frontal is little convex and formed of 6 or 7 pairs of closely arranged costules separated by a row of very small lacunae; the costules are flat, irregular in width, often decorated with a row of punctations; the apertural bar is wide, convex, and forms a crescent around the poster. The aperture is semicircular; two false cardelles placed very low, in the vicinity of the proximal border, separate a large anter from the poster; the distal peristome is thin, salient, and bears small spines. The ovicell is hyperstomial, deeply embedded in the distal zooecium, closed by the operculum, large, convex, carinated, mitriform. A pair of auriform vibracula always accompany each aperture; they are symmetrically placed on each side of the aperture and prolong the apertural bar. The zooecia of the exterior lamellae are smaller than those of the inner lamellae of the same zoarium.

Measurements.—

Zooecia (interior) Lz=0.54–0.63 mm., lz=0.25–0.29 mm.

Zooecia (exterior) Lz=0.45–0.47 mm., lz=0.21–0.27 mm.

Apertura ha=0.09 mm., la=0.07 mm.

34 zooecia in 4 sq. mm on exterior lamellae, 22 on interior.

Variations.—The strange variation, and one that has long disturbed us, is the great difference in the measurements of the interior and the exterior cells of the same multilamellar colony. The bilamellar zoaria show the largest zooecia. The more the lamellae increase in number, the smaller the zooecia become. This variation for a long time caused us to believe that two species were included under Morton's name.

Structure.—The ovicelled zooecia have an internal and external aperture of the same form and dimensions; therefore, the opercular valve closes the ovicell. There is no visible variation in the micrometric measurements of the aperture; therefore, the opercular valve was strongly chitinous, perhaps detachable, and attached to an ectocyst covering the entire zooecium.

The apertural vibracula are very constant; rarely one of them is lacking or changed in position; these are true zooecial organs absolutely indispensable. The transverse section indicates that the basal (median) lamella is not separable into two special lamellae. Further, the successive lamellae are independent of one another.

The large dimensions of certain fragments causes us to believe that the entire colony was very large and that the entire development of such a fragile ensemble could have occurred only in calm, deep water. The zoarial base has not yet been discovered.

Lang, 1921, has figured only the external zooecia.

Occurrence.—Vincentown limesand: Very common at Timber Creek and Mullica Hill and at Vincentown, N.J., not so abundant near Blackwoodstown, N.J., and at Noxontown Millpond, Del.

Plesiotype.—U.S.N.M. No. 73932.

PLIOPHLOEA ELEGANS, new species

PLATE 12, FIGURE 8

Description.—The zoarium is encrusting. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, with elegant aspect; the frontal is convex, bordered by small lateral tuberosities, formed of 8 to 10 pairs of costules separated by lines of very small lacunae; the costules are narrow, regular, granular; they begin at the peripheral tuberosities and unite at the other extremity under a small longitudinal crest. The apertural bar is thick, crescentic, widest in the middle. The aperture is small, terminal, semielliptical,

transverse; the poster is rectilinear and separated from the anter by two minute pseudocardelles placed very low; the distal peristome is thin, salient, probably ornamented with small spines. The ovicell is hyperstomial, buried in the distal zooecium, closed by the operculum, large, globular, smooth, elongated, decorated with a salient, median, longitudinal crest. The vibracula are interzooecial, small, irregularly scattered, but often grouped around the apertures.

Measurements.—

Zooecia $\begin{cases} Lz = 0.3\text{–}0.45 \text{ mm.} \\ lz = 0.25\text{–}0.3 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.05 \text{ mm.} \\ la = 0.06\text{–}0.07 \text{ mm.} \end{cases}$

30–32 zooecia in 4 sq. mm.

Structure.—The distal extremity of the vibracula is salient, and as a result the orifices are oriented obliquely toward the proximal portion of the zooecia. This arrangement is not always constant.

The zooecia have a small proximal gymnocyst, although almost always it is hidden by the ovicell or by the vibracula.

It is difficult to interpret the irregularity of the vibracula. There are always at least two to a zooecium. Often a third is added if a new series forms. Finally, certain of them appear to replace zooecia that cannot develop normally because of irregularity of gemmation.

The granules which decorate the costules correspond perhaps to the lumen pores.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73930.

PLIOPHLOEA VENTRICOSA, new species

PLATE 11, FIGURES 6–11

Description.—The zoarium encrusts Bryozoa or shell fragments; it may also be free and formed of hollow multilamellar cylinders; the external lamella is composed of subcolonies arising from a false ancestrula. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, ventricose, often restricted in back. The frontal is convex and formed of a gymnocyst of variable size and of a median costulated area; the costules are short, wide, 8 to 11 in number, convex, salient, granulated, united except at the end; the apertural bar is thick, crescentic, enlarged laterally. The aperture is small, terminal, semielliptical, somewhat transverse; two minute false cardelles placed very low in the vicinity of the proximal border separate the large anter from the poster. The ovicell is hyperstomial, embedded in the distal zooecium, closed by the operculum: it is large, convex, smooth, with a quite salient median keel. The zooeciules, large or small, are primoserial or arranged in chains

between the zooecia; their orifice is terminal, elliptical, very small, and forms a longitudinal slit narrowed laterally; their gymnocyst is always smooth.

Measurements.—

Zooecia { Lz=0.54 mm. / lz=0.27–0.3 mm. } Apertura { ha=0.07–0.09 mm. / la=0.09 mm. }

Structure.—The number of superposed lamellae forming the large tubular colonies varies from 5 to 7; they are thin and have no connection with one another. Each is formed of an adjacent subcolony arising from a false ancestrula, a small zooecium formed from a zooecium of the inferior lamella and overlapped on the other. This is the almost general rule in all the multilamellar cheilostome Bryozoa.

The zooecial structure is identical with that of *Pliophloea sagena* Morton, 1834. The opercular valve is very chitinous and perhaps separable, articulated on the two false cardelles serving as a pivot; it was attached to the external ectocyst covering the zooecium.

It is difficult to recognize the function of the zooeciules. They are analogous to those that we have studied in *Distansescharella*, but they are very different from the interzooecial kenozooecia in *Amphiblestrum abortivum* (Gabb and Horn, 1862), for their orifice is always terminal and never median. Sporadically, especially in the concave portions of the substratum, they replace the zooecia and form groups. Around the false ancestrula, they are isolated and always primoserial. In the zoarial portions farther away they are more numerous and approach one another close enough to form small chains between the cells.

The gymnocyst of the cells is not always apparent; it disappears under the ovicells or the zooeciules, or indeed it is much reduced with the greater development of the costulated area. The peristome bears three or four small spines scarcely discernible.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J., and Noxontown Millpond, Del.

Cotypes.—U.S.N.M. No. 73929.

Genus NANNOPORA Lang, 1916

NANNOPORA(?) MINIMORA, new species

PLATE 12, FIGURE 7

Description.—The zoarium encrusts *Coscinopleura*. The zooecia are distinct, separated by a deep furrow, elongated, elliptical, swollen. The frontal is convex and formed by 14 radiating costules ornamented with pelmatidia and separated by rows of 3 or 4 vacuoles. The aperture is very small, semielliptical, transverse; the peristome

is complete, with a thick, proximal border and six spines on the distal border. The ovicell is hyperstomial, closed by the operculum, globular, smooth. Avicularia sporadic.

Measurements.—

Zooecia { *Lz* = 0.5 mm. / *lz* = 0.35 mm. Apertura { *ha* = 0.03 mm. / *la* = 0.05 mm.

11 zooecia in 1 sq. mm.

Structure.—Here, as in other species of the genus, there is no separate apertural bar, for it is joined to the peristome, of which it thus constitutes the proximal lip.

The general aspect is that of *Cribrilaria radiata* Moll, 1803, from the Recent seas. Certain secondary decorations on the costules appear to be the only difference. The genotype itself, *Reptescharella pygmaea* D'Orbigny, 1852, from the French Senonian, appears simply to have a larger aperture. The constant form of the aperture indicates a frontal covered by the ectocyst and a much chitinized operculum.

Occurrence.—Vincentown limesand: Very rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 73918.

Family PELMATOPORIDAE Lang, 1916

Genus RHINIOPORA Lang, 1916

RHINIOPORA TUBULOSA, new species

PLATE 12, FIGURES 2, 3

Description.—The zoarium encrusts *Coscinopleura* and the debris of shells; oftenest it is a small, free, hollow tube probably covering a small algal filament. The zooecia are distinct, separated by a furrow, large, elliptical, elongated; the frontal is convex, bearing 19 to 21 narrow, radiating costules, decorated with pelma and with pelmatidia and separated by rows of numerous vacuoles. The aperture is terminal, semielliptical, transverse; the apertural bar is wide, distinct, separated from the peristome, of the same nature as the costules; the distal peristome is very thin, salient, with two short spines. The ovicell is hyperstomial, closed by the operculum, large, globular, smooth. In many of the interzooecial angles there is a small triangular avicularium with a pivot, generally transverse.

Measurements.—

Zooecia { *Lz* = 0.72–0.81 mm. / *lz* = 0.36–0.45 mm. Apertura { *ha* = 0.16 mm. / *la* = 0.2 mm.

13 zooecia in 4 sq. mm.

Structure.—On the costules there are punctations, which Lang calls pelmatidia. The proximal punctation is frequently larger and constitutes then a pelma.

The avicularia are oftenest grouped around the aperture without fixed place; there are rarely two of them and frequently none at all. Their orientation is variable. The primoserial avicularia are transverse; the others are oriented proximally.

On the interior of the small zoarial tubes the zooecia are visible and distinct; they all bear a distinct distal tuberosity. These tuberosities separate the rigid basal lamella from the flexible substratum; they glide over it and thus prevent the rupture of cells.

The aperture having constant dimensions, the frontal is covered by the ectocyst, and the opercular valve is much chitinized. As the aperture of the ovicelled zooecia has the form and the dimensions of the others, the operculum closes the ovicell.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J.

Cotypes.—U.S.N.M. No. 73915.

RHINIOPORA PARVIROSTRATA, new species

PLATE 12, FIGURE 1

Description.—The zoarium encrusts fragments of shells. The zooecia are distinct, separated by a furrow, elongated, elliptical, rather large, swollen; the frontal is convex and formed of 16 to 18 flat, radiating costules much crowded and separated by rows of minute vacuoles. The aperture is terminal, semielliptical, transverse; the apertural bar is distinct, separated from the peristome by a furrow; it is smooth and of the same nature as the costules. The distal peristome is thin, smooth, salient, ornamented with two short spines. The ovicell is hyperstomial, closed by the operculum, embedded in the distal zooecium, large, globular, smooth. In many of the interzooecial angles there is a very small avicularium, triangular, without a pivot indifferently oriented.

Measurements.—

Zooecia { Lz=0.6–0.7 mm. / lz=0.35–0.4 mm. } Apertura { ha=0.11 mm. / la=0.15 mm. }

16 zooecia in 4 sq. mm.

Affinities.—The structure is absolutely identical with that of *Rhiniopora tubulosa*, but *R. parvirostrata* differs in its smaller micrometric measurements, in its narrower rows of vacuoles, in the relatively much smaller apertural bar, and above all in the extreme minuteness of the avicularia. One might naturally ask what is the use of such small avicularia for such large cells.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond, Del.

Cotypes.—U.S.N.M. No. 73916.

Genus KELESTOMA Marsson, 1887

KELESTOMA SIMPLEX, new species

PLATE 12, FIGURE 4

Description.—The zoarium is encrusting. The zooecia are distinct, separated by a furrow or by "lacunae", large and variable in form, elliptical, much elongated; the frontal is convex and formed of 9 to 12 wide costules, decorated with pelmatidia, much separated from one another and joined at their extremity with the median longitudinal axis; the apertural bar is formed by the first pair of costules absolutely identical with the others. The aperture is semielliptical, invisible, buried at the bottom of a long peristomie; it is protected by a single convex arch arising from the oral avicularia and attached to the first pair of costules by a median trabecula, which is often perforated. The peristomice (or visible orifice) is semielliptical, transverse, irregular. It is accompanied laterally by two triangular avicularia with a pivot, in which the beak is oriented proximally toward the longitudinal zooecial axis. The ovicell is hyperstomial, not closed by the operculum, opening into the peristomie, very small, little convex, and little visible.

Measurements.—

Zooecia { Lz=0.75–0.82 mm. / lz=0.35 mm. } Peristomice { hp=0.12 mm. / lp=0.15 mm. }

13 zooecia in 4 sq. mm.

Affinities.—This and the following species belong to the group that Lang, 1922, called Kelestominae and Tricephaloporinae and that the zoologists place in the genus *Gephyrotes* Norman, 1903. The structure of the frontal arch protecting the aperture has been admirably illustrated by Lang (p. 26, fig. 8). Waters, 1923,[10] confirmed this structure also by an equally good drawing, but he ascribed another origin to it.

Here the structure is simpler. The arch is attached to the oral avicularia and by a median trabecula to the first pair of costules serving as an apertural bar. In the other species the arch is bifurcated in the middle with two other attachments on the apertural bar (Waters), or according to Lang, it is the apertural bar that is bifurcated and attached on the median axis to the arch formed by the fusion of two oral spines.

The protective arch, moreover, is still more complicated in *Morphosmopora* and often becomes unrecognizable when it is more or less covered by secondary calcification.

[10] Waters, A. W. Mediterranean and other Cribrilinidae. Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 564, pl. 18, figs. 4, 5, 13, 14, 1923.

We have discovered a similar structure of a protective arch in the Galeopsidae; but here, as has been remarked by Waters, there is no formation of a spiramen, that is to say a special conduit indispensable for the movement of the operculum.

The orifice, visible exteriorly, is then never closed by the operculum; it is a false aperture terminating a peristomie. In the other Bryozoa we have given the name of peristomice to such an orifice. We think that this term could perhaps also be employed for the Cribrimorphs.

According to the classification of Lang, it would be necessary to create a special genus for *Kelestoma simplex*. Simple or complex, a protective arch is always a protective arch. Not only do we think it unnecessary to create a new genus, but we feel that *Morphosmopora* could well be joined with *Kelestoma*.

Occurrence.—Vincentown limesand: Very rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 73917.

Genus TRICEPHALOPORA Lang, 1916

TRICEPHALOPORA PROLIFERA Gabb and Horn, 1862

FIGURE 1, D; PLATE 13, FIGURES 1, 2

1862. *Reptescharellina prolifera* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 146, pl. 20, fig. 28.

1907. *Reptescharellina prolifera* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, pp. 167, 346, pl. 25, fig. 2 (bibliography).

1922. *Tricephalopora prolifera* LANG, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 4, pt. 2, p. 74, text fig. 21 (bibliography).

Description.—The zoarium encrusts free Bryozoa such as *Pliophloea sagena* and *Coscinopleura digitata*. The zooecia are distinct, separated by a deep furrow, little elongated, swollen, capitate; the frontal is very convex and formed of a smooth, thick epicalcification, at the center of which is an elliptical costulated area; the costules to the number of four are short, radiating, much scattered, united only at their extremity; the apertural bar is of the same nature as the costules but a little thicker. The aperture is invisible, buried at the bottom of the peristomie, covered by a thick arch arising from the two oral avicularia and below which is a wide, elliptical, transverse pseudospiramen. The peristomice is elliptical, transverse, larger on the ovicelled zooecia. The ovicell is hyperstomial, buried in the distal zooecium, not closed by the operculum, large globular, smooth. The two oral avicularia are large, triangular, thin, with a pivot, with the beak pointed and oriented proximally toward the apertural bar. The ancestrula is a small ordinary zooecium.

Measurements.—

Zooecia $\begin{cases} Lz = 0.55\text{–}0.65 \text{ mm.} \\ lz = 0.4\text{–}0.5 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hp = 0.11 \text{ mm.} \\ lp = 0.17 \text{ mm.} \end{cases}$

Variations.—The superficial calcification or epicalcification is a common phenomenon in all the cheilostomatous Bryozoa, and it has been well known since the time of Milne Edwards, 1838. It is little evident in the Membranipores where the frontal is chitinous, but it is much more frequent in the derived Cribrimorphs, where it is still more complicated by the proliferation of the oral spines. Lang, 1922, has well shown its importance; he designates as "connecting tissue" or "secondary tissue" the calcareous deposits that invade the frontal of many Cribrimorphs when they fill up the intercellular interspaces.

On many of the old zooecia of *Tricephalopora prolifera* the costulated area becomes scarcely visible and assumes the aspect of a simple stellate pore, which is filled up in fossilization. Such zooecia are rare, but it is probable that the drawing of Gabb and Horn was based on this kind. We follow Lang, 1922, in the belief that Ulrich and Bassler, 1907, were correct in their interpretation of the incomplete figure of Gabb and Horn. Moreover, in spite of the great abundance of accumulated material in the National Museum, no other species resembling this figure has been discovered. It is therefore best to maintain the synonymy as noted above.

The peristomie develops on the distal zooecium; it is much developed in *Haplocephalopora* Lang, 1916, a superfluous genus in our opinion, because the length of the peristomie is a trivial character.

Affinities.—*Tricephalopora* having the avicularia oriented proximally are rare. We know only *T. saltdeanensis* Lang, 1916, from the English Campanian, and the American species differs from it in the presence of a single pseudospiramen. Nonovicelled zooecia are rare, so that the species is well named.

Occurrence.—Vincentown limesand: Not rare at Mullica Hill, Vincentown, and near Blackwoodstown, N.J. Rare at Noxontown Millpond and 2 miles southwest of Odessa, Del.

Plesiotype.—U.S.N.M. No. 73924.

TRICEPHALOPORA ACUTIROSTRIS, new species

PLATE 13, FIGURES 3, 4

Description.—The zoarium is free, unilamellar. The zooecia are indistinct, surrounded by a thick epicalcification, little elongated, subelliptical; the frontal bears eight very short costules arranged at the bottom of an elliptical area and below an apertural bar similar to the costules; the peristomie, short but thick, begins with a pseudospiramen placed above the costules and bears laterally two long triangular, pointed, straight avicularia with a pivot. The aperture is invisible and buried at the bottom of the peristomie. The peristomice is terminal, semielliptical, transverse, irregular, surrounded with a thick epicalcification. The ovicell is hyperstomial, not closed by the operculum, opening into the peristomie,

salient, convex. The peristomice of the ovicelled zooecia is suborbicular.

Measurements. —

Zooecia (including avicularia) $\begin{cases} Lz = 0.65 \text{ mm.} \\ lz = 0.4 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hp = 0.1 \text{ mm.} \\ lp = 0.15 \text{ mm.} \end{cases}$

16 zooecia in 4 sq. mm.

Affinities.—The structure here is close to that of the Galeopsidae. An arch arising from the oral avicularia covers the aperture, leaving an empty space, a sort of pseudospiramen. This characteristic is peculiar to the American species of *Tricephalopora*, and we have found it even in the Tertiary.[11] The European species have on the contrary two symmetrical pseudospiramens with the protective arch bifurcated. *Tricephalopora acutirostris* differs from *T. prolifera* Gabb and Horn, 1862, in the distal orientation of its avicularia.

Occurrence.—Vincentown limesand: Very rare at Vincentown and near Blackwoodstown, N.J.

Holotype.—U.S.N.M. No. 73922.

TRICEPHALOPORA INCRASSATA, new species

PLATE 13, FIGURE 5

Description.—The zoarium encrusts debris. The zooecia are distinct, separated by a deep furrow, elongated, swollen, capitate; the frontal is convex, very thick, smooth, bearing at the center a small costulated circular area and terminated by a long peristomie enlarged distally. There is no pseudospiramen. The costules to the number of four are extremely small and often indiscernible. The apertura is buried at the bottom of the peristomie. The peristomice is suborbicular, irregular. The ovicell is hyperstomial, not closed by the operculum, buried in the distal zooecium, opening into the peristomie, small, convex, smooth, little salient exteriorly. The oral avicularia are triangular, with a pivot, transverse, pointed.

Measurements.—

Zooecium $\begin{cases} Lz = 0.5\text{–}0.6 \text{ mm.} \\ lz = 0.35\text{–}0.4 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hp = 0.09\text{–}0.1 \text{ mm.} \\ lp = 0.09\text{–}0.12 \text{ mm.} \end{cases}$

20–22 zooecia in 4 sq. mm.

Structure.—In this species the epicalcification is very intense; not only does it cover almost all the frontal, hiding the costules, but it also much thickens the primitive protective arch, which is then supported on the apertural bar, suppressing thus the pseudospiramen.

Affinities.—This new species differs from *T. prolifera* Gabb and Horn, 1862, in its smaller dimensions and in the absence of a pseudo-

[11] See *Cephyrotes convexus* and *C. quadriserialis* Canu and Bassler, U.S.Nat.Mus.Bull. 106, pp. 301, 304, 1920.

spiramen. It differs from *Haplocephalopora uniceps* Lang, 1910, from the Danian of Faxe in its shorter dimensions, in its transverse and longer avicularia, and in its shorter peristomie, which is enlarged distally.

Occurrence.—Vincentown limesand: Very rare at Vincentown, N.J., and at Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73925.

Genus POLYCEPHALOPORA Lang, 1916

POLYCEPHALOPORA BIROSTRATA, new species

PLATE 14, FIGURES 1–3

Description.—The zoarium encrusts shells and *Coscinopleura* and may attain 2 cm in diameter. The zooecia are distinct, separated by a shallow furrow, elongated, elliptical or oval; the frontal is convex, formed of 12 to 16 costules and of an orbicular, wide median area of fusion; the costules are decorated with a distal pelma and a proximal pelma; the apertural bar is wide, convex, arched, united with the distal peristome. The apertura is large, terminal, oblique, suborbicular; the distal peristome is thin, little salient, decorated with small spines. The ovicell is hyperstomial, not closed by the operculum, buried in the distal zooecium, large, globular, elongated, oval, smooth. Each zooecium bears laterally two large avicularia, symmetrically arranged below the aperture; they are elliptical, salient, with a pivot, with beak rounded and oriented distally. The primoserial avicularia are oriented transversely. The ancestrula is very small, membraniporoid, and thin, with two large, salient avicularia.

Measurements.—

Zooecia { Lz=0.6–0.65 mm. / lz=0.35–0.4 mm. } Apertura { ha=0.15 mm. / la=0.15 mm. }

14 zooecia in 4 sq. mm.

Variations.—The ancestrular zooecia are very small; their dimensions are scarcely half the normal zooecia; but in all their characters they are absolutely analogous.

The ovicells are buried in the distal zooecium in which the number of costules is thus diminished.

Lang, 1922 (p. 43, fig. 15), has well schematized the formation of the wide median area of fusion, but here the pelmatidia are replaced by the pelma. It is, moreover, difficult to differentiate these two kinds of cicatrices ornamenting the costules.

The theoretical order of the avicularia is often altered by the presence of ovicells and by that of the primoserial avicularia. In appearance the avicularia seem to be irregularly scattered, but in

counting them and observing the transverse arrangement of the primoserial avicularia it is easy to prove that their presence and position are nearly constant.

The apertural bar rises to the level of the ovicell and thus protects its orifice. If the frontal were covered with an ectocyst, the opercular valve would be thin and flexible.

Affinities.—Because of the number of avicularia we ought to place this species in *Phractoporella* Lang, 1916; but there is no epicalcification as in that genus. The number of avicularia (2 instead of 3 or 4) and the presence of the pelma in place of the pelmatidia do not permit us to place it in *Polycephalopora* Lang, 1916. We must hesitate, but in taking account of the other characters—avicularia, ovicell, and costules—it is undoubted that this species is a *Polycephalopora.* Moreover, the genera *Phractoporella* and *Coelopora* could well be united, and we do not believe that a special genus should be created for an avicularium or less. Neither of these genera has been yet discovered in the Danian. This species is well characterized by its orbicular frontal area. The avicularia are identical with those of *Callopora jerseyensis* Ulrich and Bassler, 1907. They have the same form and are oriented transversely when they are primoserial. The ovicells have also the same oval form.

Occurrence.—Vincentown limesand: Not rare at Vincentown, N.J.

Cotypes.—U.S.N.M. No. 73920.

Genus ANORNITHOPORA Lang, 1916

ANORNITHOPORA (?) FRAGILIS, new species

PLATE 12, FIGURES 5, 6

Description.—The zoarium encrusts *Pliophloea sagena* and shell fragments. The zooecia are large, distinct, separated by a deep furrow, elliptical, broad, elongated; the frontal is convex, fragile, and formed of 14 to 16 costules, which are broad, separated from one another by a long lateral and a small median lacuna; the line of fusion outlines a small elliptical median area; the apertural bar is distinct, wide, smooth. The apertura is terminal, transverse, semicircular; the distal peristome is thin, salient, and decorated by two large proximal tuberosities. The ovicell is hyperstomial, closed by the operculum, buried in the distal zooecium, globular, small, smooth.

Measurements.—

Zooecium $\begin{cases} Lz = 0.72 \text{ mm.} \\ lz = 0.45\text{–}0.54 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.11 \text{ mm.} \\ la = 0.18 \text{ mm.} \end{cases}$

Affinities.—In the classification of Lang, we do not know exactly where to place this species, for we have been able to discern neither

the pelma nor the pelmatidia, small ornaments that easily disappear in fossilization. We have placed it in *Anornithopora* because of the absence of avicularia and of the identity of the frontal with that of *Anornithopora implumis* Lang, 1916, of the English Campanian. Moreover, in its generic description (p. 165) the author does not give a single positive character.[12]

The species differs from *Anornithopora implumis* Lang, 1916, in its semicircular aperture, its larger dimensions, and in the presence of two oral tuberosities.

The same frontal structure is observable in the Recent *Membraniporella nitida intermedia* Norman, 1909 (Madeira), but the present species differs in the absence of distal spines and of avicularia. It differs finally from *Lagynopora horsleyensis* Lang, 1916, from the English Senonian, very similar in aspect, in the presence of two lacunae only (and not three), in its noncircular aperture, and in the absence of a "median projection" on the apertural bar.

The costules are very fragile and break so easily that there are few complete zooecia on the zoaria.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 73919.

Genus HESPEROPORA Lang, 1916

HESPEROPORA OCCIDENTALIS Lang, 1916

FIGURE 1, B, C; PLATE 13, FIGURE 9

1916. *Hesperopora occidentalis* LANG, Ann. Mag. Nat. Hist., ser. 8, vol. 18, p. 98.
1922. *Hesperopora occidentalis* LANG, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 4, pt. 2, p. 171, text fig. 53a, b, pl. 3, fig. 12.

Diagnosis.—*Hesperopora* with zooecia not much longer than wide; secondary aperture not well formed, and subcircular; costae about 16.

Description.—The zoarium is encrusting, unilamellar. The zooecia are monomorphic.

The adult zooecia, about 0.5 mm long and 0.35 mm wide, are wide oval, the gymnocyst is of small extent but not hidden by interzooecial secondary tissue; the frontal is well arched, consisting of about 16 costae, each bearing 4 or 5 very small pelmatidia and having about the same number of wide lateral costal fusions, leaving but very small perforations (lacunae) between the costae; the costae are firmly united in a median band of fusion; the apertural bar is flattened in a distal-proximal direction and extended to form the proximal shield of a secondary aperture; the aperture is suboval or

[12] "Small Castanoporinae with comparatively few costae (20 or less), with no secondary aperture and no or very few avicularia." A large number of very distinct species could be classed under this definition.

subcircular; the secondary aperture is subcircular; there are four spines, somewhat thickened.

The ancestrula, about 0.36 mm long and 0.18 mm wide, is elliptical; the gymnocyst is of small extent and not hidden by secondary tissue (epicalcification); the frontal is well arched, consisting of about 12 costae, each with about 3 pelmatidia and 3 pairs of wide costal fusions which leave but very small perforations (lacunae) between the costae; the costae are firmly united in a median band of fusion; the apertural bar is much raised in the neighborhood of a pair of pelmatidia; the apertura is subcircular, flattened proximally; there are five apertural spines.

Remarks.—The presence of five apertural spines in the ancestrula of *Hesperopora occidentalis* [13] is of interest in showing that the four apertural spines are a reduction of a larger ancestral number. *H. occidentalis* is more primitive in many characters than *H. danica*, and it may be considered as ancestral to that form.[14]

Occurrence.—Vincentown limesand: Near Blackwoodstown, N.J. (very rare).

Plesiotype.—U.S.N.M. No. 73921.

Genus STICHOCADOS Marsson, 1887

STICHOCADOS COMPOSITUS Lang, 1916

FIGURE 1, A; PLATE 13, FIGURES 6, 7

1916. *Stichocados compositus* LANG, Ann. Mag. Nat. Hist., ser. 8, vol. 18, p. 98.
1922. *Stichocados compositus* LANG, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 4, pt. 2, p. 178, text fig. 57, pl. 4, fig. 3.

Diagnosis.—" Stichocados with about 9 costae; 3 or 4 lateral costal fusions (?); length 0.5 mm; a pair of small apertural avicularia."

Description.[15]—The zoarium is free, unilamellar in small masses of 2 to 3 mm in diameter. The zooecia, about 0.5 mm long and 0.4 mm wide, are oval, bottle-shaped, erect; the mural rim is of very small extent; little or no interzooecial calcification; the frontal is well arched, consisting of about 9 costae, each with 3 or 4 pelmatidia and 3 or 4 pairs of lateral costal fusions [16] united in a median band of fusion; the apertural bar is probably formed as in the last species, that is, with a median projection that fuses with lateral structures, but in this case a pair of apertural avicularia replaces the proximal pair of apertural spines to form a fenestrated proximal shield of a

[13] We have not rediscovered good specimens of this species in our collections and are giving Lang's text, but in our usual terminology.

[14] On the figures given by Lang we cannot see distinctly the two apertures of which he speaks.

[15] A combination of Lang's text with our own notes.

[16] The lateral costal fusions are the trabeculae separating the lacunae.

secondary aperture (peristomice); the distal shield appears to be solid and formed by the upward prolongation of the apertural ring, which replaces the distal pair of apertural spines. The avicularia, a small apertural pair, are carried upon the secondary apertural ring and replacing the proximal pair of apertural spines, directed toward the center of the aperture of the zooecium it accompanies somewhat elongate with rather blunt apertures.

Remarks.—Were it not for the presence of avicularia and the somewhat smaller size, *Stichocados compositus* might have been derived from *S. verruculosus* (Maastrichtian). On the assumption, however, that *S. verruculosus* was derived from *Carydiopora* by the loss of avicularia as well as by the acquisition of a secondary aperture, *S. compositus*, which has not yet lost its avicularia, is more primitive in this respect.

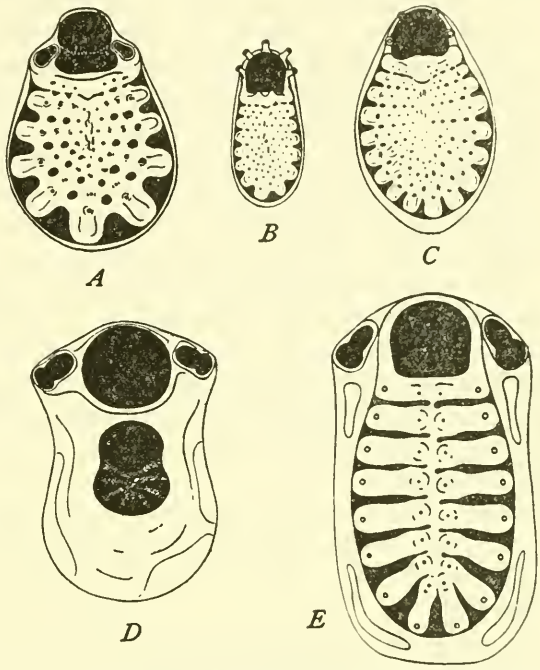


FIGURE 1.—*A, Stichocados compositus* Lang, 1916, diagram of a zooecium (× 75) showing the frontal structure; *B, C, Hesperopora occidentalis* Lang, 1916, diagram of an ancestrular and a normal zooecium (× 75); *D, Tricephalopora prolifera* Gabb and Horn, 1862, zooecium (× 75) showing general structure; *E, Diacanthopora abbottii* Gabb and Horn, 1862, zooecium (×75)—the talon of the avicularium should be placed on the mural rim of the adjacent zooecium. (After Lang, 1922.)

Measurements.—

Zooecia $\begin{cases} Lz = 0.5 \text{ mm.} \\ lz = 0.4 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.11\text{–}0.13 \text{ mm.} \\ la = 0.1\text{–}0.11 \text{ mm.} \end{cases}$

24 zooecia in 4 sq. mm.

Variations and structure.—Lang, 1922, has given a masterly interpretation of the structure of the curious genus *Stichocados* Marsson, 1887, and it required all his experience in the study of the Cribrimorphs to understand its complexities. He had for this study only the four figured cells (pl. 4, fig. 3), which were sufficient for his schematic figure 57. So it is not surprising that he omitted the for-

mation of the peripores both on the genotype *S. verruculosus* as well as on *S. compositus*, although he has indicated them on his figures 1 and 3. The zooecia that he figured are either worn or have an incompletely formed frontal. In reality the frontal is covered by 3 or 4 transverse rows of salient peripores, their growth corresponding to the lacunae, as one can see on our figure. The zooecia thus ornamented are the commoner; the others are rare.

All the apertural armature is more or less salient, forming thus a sort of peristomie. When it is not salient, the distal peristome (the distal shield of Lang) appears to be solid; but if it is salient the three distal fenestrae indicated on *S. verruculosus* and on *S. ordinatus*, appear distinctly at the base of the armature upon inclining the preparation. A curious consequence of this variation is that the peristomice and the apertura have an identical form.

The formation of frontal peripores is a phenomenon not rare in the Cribrimorphs. We have noted it in the genus *Acanthocella* Canu and Bassler, 1917, in *Cribrilina verrucosa* Canu and Bassler, 1920, of the Midwayan, and it has been known for a long time on the *Cribrilina cryptoecium* Norman, 1903, of Recent seas. We still do not understand their significance, and Lang himself does not discuss them.

On *S. compositus*, the proximal shield, that is, the proximal portion of the peristomice, is not developed. It varies a great deal according to the species and even among the zooecia of the same specimen.

Occurrence.—Vincentown limesand: Very rare near Blackwoodstown and at Vincentown, N.J.

Plesiotypes.—U.S.N.M. No. 73911.

STICHOCADOS MUCRONATUS, new species

PLATE 13, FIGURE 8

Description.—The zoarium is encrusting. The zooecia are distinct, separated by a deep furrow, little elongated, oval or claviform; the frontal is convex and formed of 8 to 10 costules almost entirely joined together and separated only in their proximal portion by a large lacuna; the proximal shield is formed by the much thickened apertural bar, salient, bearing a large salient mucron, covering in part the apertura; the distal shield is formed by the more or less complete fusion of 4 distal spines placed above the avicularia and more or less united laterally to the proximal shield. The apertura is semicircular with a straight proximal border. On each side of the apertura there is a small triangular avicularium with a pivot, arranged almost transversely; the beak is very pointed and oriented toward the center of the apertura. The ovicell is hyper-

stomial, not closed by the operculum, buried in the distal zooecium, small, globular, smooth, ornamented with two lateral cicatrices placed symmetrically. The ancestrula is a small ordinary zooecium.

Measurements.—

Zooecium { *Lz* = 0.6–0.75 mm. / *lz* = 0.35–0.4 mm. } Apertura { *ha* = 0.09–0.11 mm. / *la* = 0.1 mm. }

20 zooecia in 4 sq. mm.

Structure and variations.—We have noted in *Stichocados compositus* that the distal peristome is unequally developed in order to form the distal shield. Here in *S. mucronatus* it is unequally formed; on the young cells, on the ancestrular cells, and on the ovicelled zooecia the spines are free; on the adult nonovicelled zooecia only it is formed by the fusion of spines, which thus disappear or leave only faint traces. On the latter zooecia, each aperture appears thus surrounded by a complete thickened peristome.

On the ancestrular zooecia, the avicularia are separated from the peristome, but on other zooecia they are united to the peristome and separate the proximal shield from the distal shield. The widest zooecia do not always have their costules entirely joined, but they are sometimes separated by two lacunae. Pelmatidia are visible on the well-preserved costules. They are never peripores as in *Stichocados compositus*. This is the only species of *Stichocados* in which the ovicells have been observed.

Occurrence.—Vincentown limesand: Very rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 73910.

Genus DIACANTHOPORA Lang, 1916

DIACANTHOPORA ABBOTTII Gabb and Horn, 1862

FIGURE 1, E; PLATE 14, FIGURES 4–7

1862. *Escharipora abbottii* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 149, pl. 20, fig. 33.

1922. *Diacanthopora abbottii* LANG, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 4, pt. 2, p. 233, text fig. 72, pl. 5, fig. 5 (bibliography).

Description.—The zoarium is free, erect, bilamellar, of large flat or undulated fronds. The zooecia are distinct, separated by a deep furrow, large, elongated, elliptical, bearing all around a strong individual epicalcification, forming a mural rim much enlarged proximally; the frontal is convex and formed of 14 costules (10 to 20) much scattered and united only along the median axis by their distal extremity. The costules are flat, ornamented with proximal pelma and a distal pelmatidia (or a pelma); the apertural bar is a concave arch of the same structure as the costules. The apertura is suborbicular, large, terminal, variable; the distal peristome is thin, with four spines on the little calcified zooecia, thick and without

spines on the others. The ovicell is hyperstomial, not closed by the operculum, buried in the distal zooecium, large globular, smooth. Each zooecium bears theoretically two oblique triangular avicularia with a pivot or with denticles, placed at the level of the apertures of the adjacent zooecia; the beak is very pointed and arranged in accord with the peristome of the adjacent zooecia, as well shown in Gabb and Horn's figure.

Measurements.—

Zooecium { *Lz*=0.75–0.85 mm. / *lz*=0.4–0.5 mm. } Apertura { *ha*=0.2 mm. / *la*=0.17–0.2 mm. }

10–13 zooecia in 4 sq. mm.

Variations.—The dimensions are quite variable. On the vigorous specimens the zooecial length attains 1 mm and the width 0.5 mm. The number of costules varies accordingly for on the long zooecia it is about 20 and on the shortest it is only 10.

When the zoarium develops regularly the zooecia remains quite elliptical; but when the gemmation is deranged, they are much constricted and become fusiform.

The avicularia do not have the theoretic regularity, for this depends exclusively on the regularity of the gemmation. When this becomes irregular, the avicularia disappear or are oriented differently, then some zooecia have a single avicularium and others are deprived of them.

Lang's figure 72 is incorrect, for the avicularia do not belong to the zooecium, where they appear to be placed. Their base is always placed on the adjacent zooecium, and it is the beak only that is more or less united with the distal part of the peristome. The avicularium is always placed below the transverse median axis of a zooecium. It develops only if there is an aperture of a neighboring zooecium at its height. If through irregular gemmation there is no aperture, it does not develop at all. This phenomenon of interconnection is remarkable, but it is not unique, for it has been observed in other genera of the Cheilostomata.

The costules are irregularly decorated. The pelma and pelmatidia are often absent. The proximal pelma is rather constant; the distal pelmatidium often is transformed into a true pelma.

The epicalcification that occurs around each zooecium is important. It is rather regular and envelops the distal spines, which disappear, become invisible, or leave only faint traces. It is frequently more intense at the base of the zooecia. According to its thickness, it diminishes the length of the spines when it spreads over the frontal. It rarely fills in the cellular intervals.

The aperture is not rigorously orbicular. It is somewhat elongated and restricted laterally; its proximal border is simply convex.

It is so irregular in form and dimensions that we must suppose the opercular valve does not correspond to it exactly. It is therefore more an opesium in which the distal portion only was covered by the opercular valve.

The arrangement of the apertural bar causes us to believe that the zooecium was covered by the ectocyst and the great importance of the epicalcification confirms this hypothesis, since it cannot occur above the ectocyst.

The ovicells are very rare, although we have numerous fragments of zoaria. The colonies must have been very large but relatively fragile because of the slight thickness of the fronds.

Occurrence.—Vincentown limesand: Mullica Hill, Vincentown (common), and near Blackwoodstown (rare), N.J.; Noxontown Millpond, Del. (rare).

Plesiotype.—U.S.N.M. No. 73905.

DIACANTHOPORA DISTANS Gabb and Horn, 1862

PLATE 14, FIGURES 8, 9

1862. *Escharipora distans* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 148, pl. 20, fig. 32.

1922. *Diacanthopora distans* LANG, Catalogue of Cretaceous Bryozoa in the British Museum, vol. 4, pt. 2, p. 235 (bibliography).

Description.—The zoarium encrusts fragments of sea urchins, shells, and other Bryozoa. The zooecia are distinct, elongated, elliptical, united together by an intense calcification forming a thick mural rim, salient; the frontal is little convex and formed of 8 to 10 separated costules attached only at their extremity to a salient median crest; each costule is decorated with a proximal pelma; the apertural bar is broad, distinct, little concave, of the same structure as the costules. The apertura is suborbicular with the proximal border straight or a little concave; the distal peristome is thin, with four spines on the little calcified zooecia, thick and smooth on the others. The ovicell is hyperstomial, not closed by the operculum, resting on the especially developed gymnocyst of the distal zooecium, which thus becomes longer; it is surrounded by a thick circle of frontal epicalcification, at the center of which is a shallow circular area. Two avicularia are placed symmetrically on each side of the aperture; they are triangular, oblique, with rounded beak, oriented distally toward the longitudinal axis of the zooecium.

Measurements.—

Zooecium: Lz=0.6 mm and 0.85 mm. (ovicelled). lz=0.35 mm.

Apertura: ha=0.15 mm. la=0.15 mm.

15 zooecia in 4 sq. mm.

Variations.—The special character of this species is that figured by Gabb and Horn, 1862; the ovicelled zooecia are in appearance longer than the others and measured 0.85 mm instead of 0.60 mm. In reality it is the distal zooecium that is elongated by a distance equal to that of the proximal ovicell; it develops a gymnocyst on which the ovicell rests.

The phenomenon of epicalcification, well figured although exaggerated by Gabb and Horn, is here quite apparent. It fills the intervals between the cells, thus forming a thick mural rim. It completely surrounds the ovicell and forms around it a veritable crown. Spines and avicularia are embedded in the calcareous material, where even their traces are not always visible.

On our specimens the number of costules is exactly that indicated by Gabb and Horn's figure, which clearly confirms our determination.

The intensity of the calcification is great, and we have been unable to verify the exact place of the avicularia. It seems to us, however, that their base is attached to the adjacent zooecia. This must be verified on better specimens.

Affinities.—The specific characters are well indicated on the diagrammatic figures of Gabb and Horn and are more apparent on our own. *Diacanthopora distans* differs from *D. abbottii* in its smaller micrometric measurements, in its smaller number of costules (8 to 10 and not 14), and in a more intense epicalcification joining all the zooecia together. The general structure is almost identical with that of *D. abbottii*, and our remarks on the reconstruction of the chitinized parts are the same.

Gabb and Horn examined only a single specimen described as follows: "Colony apparently in a tortuous anastomosing series of plates, robust, cellules on both faces." The word "apparently" indicates a slight doubt. Probably the colony examined was entirely encrusting some bilamellar species as *Coscinopleura digitata* or *Pliophloea sagena.* Our specimens are encrusting.

Occurrence.—Vincentown limesand: Rare at Timber Creek, Vincentown, and near Blackwoodstown, N.J.

Plesiotype.—U.S.N.M. No. 73908.

DIACANTHOPORA CONVEXA, new species

PLATE 8, FIGURES 2. 3

Description.—The zoarium encrusts *Pliophloea sagena.* The zooecia are distinct, separated by a deep furrow, elongated, oval, large, swollen; the frontal is convex, surrounded by an individual epicalcification, smooth, enlarged proximally, limiting an elliptical costulate area formed by 14 to 16 closely approximated costules; the latter

are united only by their distal extremity to the longitudinal median axis and are decorated by a proximal pelma and distal pelmatidia (or pelma). The apertural bar is wide, convex, of the same nature as the costules. The aperture is suborbicular, somewhat elongated, slightly narrowed laterally with a straight or concave proximal border; the distal peristome is thin and salient, with four spines on the little calcified zooecia, thick and smooth on the others. The ancestrula is a small ordinary zooecium. Each zooecium bears to the right or to the left, a little below the transverse axis, a broad triangular avicularium with denticles and with rounded beak, oriented distally, often primoserial.

Measurements.—

Zooecium $\begin{cases} Lz = 0.65\text{–}0.8 \text{ mm.} \\ lz = 0.4\text{–}0.45 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.15\text{–}0.17 \text{ mm.} \\ la = 0.12\text{–}0.15 \text{ mm.} \end{cases}$

Variations.—Epicalcification is not active and rarely goes beyond the zone of the costules; there is therefore no formation of a mural rim limiting the costulated area. Nevertheless, it surrounds the distal spines sufficiently to hide them and to thicken the distal peristome.

The avicularium is often primoserial and oriented distally; when it is not primoserial its orientation is more or less oblique. It is often adjacent to the aperture of an adjacent zooecium, but it is independent of it. Frequently the costules have two pelmata.

The aperture is irregular in its dimensions; it is more an opesium in which the opercular valve covers only the distal portion.

Affinities.—This beautiful species is quite distinct because of its convex frontal, which is not outlined by a thick mural rim as in *Diacanthopora abbottii.* It closely resembles *Pelmatopora calceata* Lang, 1916, from the Senonian of England (Chatham) but differs in its larger zooecial dimensions, in the presence of a proximal pelma on the costules, and in its large and triangular avicularium.

We believe that the two genera *Diacanthopora* and *Pelmatopora* Lang, 1916, should be united, as the character that differentiates them seems to us of little importance. In *Diacanthopora* the pelma is proximal, while it is distal in *Pelmatopora.* On the American species one can note that the distal pelmatidium is frequently transformed into a true pelma.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J.

Cotypes.—U.S.N.M. No. 73909.

DIACANTHOPORA MARGINATA Gabb and Horn, 1862

PLATE 20, FIGURE 8

1862. *Reptescharipora marginata* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 149, pl. 20, fig. 33.

1922. *Diacanthopora marginata* LANG, Catalogue of the Cretaceous Bryozoa in the British Museum, vol. 4, pt. 2, p. 232 (bibliography).

Gabb and Horn, 1862, indicated clearly the differences from their *Escharipora abbottii* " with cellules resembling *Escharipora abbotti* in form, this species can be distinguished by its being encrusting, by the greater size of the mouth and the fewer special fossettes." These differences clearly visible on the figures are important enough to justify the creation of two species. However, Ulrich and Bassler, 1907, joined the two species under the name of *Membraniporella abbotti* in the belief that *M. marginata* was the encrusting form of *M. abbottii*. Lang, 1922, does not think their assumption to be correct and again separates the two species. Ulrich and Bassler still not having discovered encrusting forms of *D. abbottii* with bilamellar expansions now abandon their former belief.

Under the circumstances *D. marginata* must remain a distinct species still not rediscovered.

Occurrence.—Vincentown limesand: Very rare at Mullica Hill, N.J.

GENERAL REMARKS ON THE CRIBRIMORPHS

The structure of the Cribrimorphs results really only from the manifestation of a single phenomenon, the fusion of the areal and distal spines of Membranimorphs combined often with epicalcification. But this simple phenomenon has engendered a great number of bizarre and fantastic combinations, and their study is therefore extraordinarily difficult. Among the bryozoologists, Jullien first and Lang in 1922 have taken up their detailed investigation, and Lang has produced a most comprehensive work but at present it appears to us that he multiplied the families and genera needlessly and that he forgot that a natural classification must be established on a study of all the characters observed. We think he was wrong to change the accepted terminology so severely and to adopt such highly technical terms. However, it must be remembered (1) that the Recent Cribrimorphs are poorly studied, and no one has found in their zoological structure the indispensable characters for comparison; (2) that they are very fragile and often altered by fossilization, and (3) that they are rare, and in order to preserve the studied specimens it is rarely possible to make the necessary dissections.

We feel that Lang's work is really masterly and indispensable to the student. Jullien and he are the only authors who have understood and interpreted the many fantasies of the Cribrimorphs. Lang has accomplished an enormous task not only in deciphering the innumerable enigmas that their skeletal development presents but also in describing the species and preparing the diagrams and superb figures. In our opinion, it alone is quite sufficient to establish his renown as a great naturalist.

Family HIPPOTHOIDAE Levinsen, 1909

Genus HIPPOTHOA (Lamouroux, 1821) Hincks, 1880

HIPPOTHOA TENUICHORDA Ulrich and Bassler, 1907

PLATE 18, FIGURE 1

1907. *Stomatopora temnichorda* (typographical error for *tenuichorda*) ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 314, pl. 20, figs. 5, 6.

Description.—The zoarium is adnate, frequently branching, consisting of uniserially arranged zooecia. The zooecia are elongate-pyriform, or club-shaped, 0.45 to 0.75 mm in length, about 0.2 mm in width at the posterior extremity, increasing very gradually in size through about one half their length, and then somewhat abruptly to about 0.15 mm at the rounded anterior end. The aperture is nearly terminal, circular, with a slightly elevated rimlike border, from 0.035 mm to 0.05 mm in diameter.

Affinities.—This minute species is difficult to study because of the small dimensions of the aperture and of its extreme fragility. It is rarely well preserved in our specimens. However, with strong magnification it is possible to see the proximal sinus characteristic of the genus *Hippothoa.* On the other hand, we have not yet discovered the ovicelled zooecia.

It is necessary to await the discovery of better specimens in order to classify generically this species more exactly.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 52618.

Genus DACRYOPORA Lang, 1914

DACRYOPORA(?) ORBIFERA, new species

PLATE 17, FIGURE 1

Description.—The zoarium is uniserial and encrusts the debris of shells. The zooecia are small, elliptical, terminated abruptly by a narrow caudal portion shorter than the zooecium; the frontal is quite convex, finely punctate, ornamented by a large transversely submedian and transverse wrinkle. The aperture is orbicular; the peristome is thin, very salient. The branches are dichotomous; their angle of divergence is variable.

Measurements.—

Zooecium $\begin{cases} Lz = 0.4\text{–}0.5 \text{ mm.} \\ lz = 0.13 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.05 \text{ mm.} \\ la = 0.05 \text{ mm.} \end{cases}$

Affinities.—In the genus *Dacryopora* Lang, 1914, the aperture is semicircular and not orbicular, so that our generic reference is then

doubtful. Our specimens are poorly preserved and too rare to make a detailed study of the species.

Occurrence.—Vincentown limesand: Very rare at Noxontown Millpond, Del.

Holotype.—U.S.N.M. No. 73890.

DIPLOTRESIS,[17] new genus

Hippothoidae in which the zooecial frontal bears two frontal pores (ascopores?). There are zooeciules with pointed beak, irregularly arranged between the zooecia. The ovicell is hyperstomial and closed by the operculum.

Genotype.—Diplotresis (*Microporella*) *sparsiporosa* Ulrich and Bassler, 1907.

In the Cyclostomata, the studies of the minute cells, nanozoids, was made by Borg, 1926. In the Cheilostomata, the study of the similar zooeciules has not yet been undertaken. Their anatomy and their function are unknown, so that it is difficult to determine the importance that should be given them in the classification.

Zooeciules analogous to those of the genus *Diplotresis* have been discovered in the membranimorph genus *Marssonopora* Lang, 1912, and in the Cribrimorphs *Otopora* Lang, 1916, and *Barroisina* Jullien, 1886.

DIPLOTRESIS SPARSIPOROSA Ulrich and Bassler, 1907

PLATE 17, FIGURES 6, 7

1907. *Microporella sparsiporosa* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 348, pl. 26, fig. 8.

Description.—The zoarium encrusts small stones and the fragments of shells. The zooecia are distinct, separated by a deep furrow, much elongated, oval or fusiform; the frontal is quite convex and perforated by a large number of small pores regularly arranged in transverse rows. The ascopore, little removed from the aperture, is formed of two small pores arranged symmetrically on each side of a small median tuberosity. The aperture is terminal, semielliptical, transverse; the peristome is complete, thin, very salient, surrounding a short peristomie. The ovicell is hyperstomial, resting on the distal zooecium, closed by the operculum, globular, large, finely punctate. The zooeciules are long narrow, fusiform, irregularly arranged between the zooecia, isolated, rarely grouped; the frontal is finely porous; the beak is quite long, acuminate, and terminated by a canalicule.

Measurements.—

Zooecia { Lz=0.65–0.7 mm. / lz=0.35–0.4 mm. } Apertura { ha=0.06 mm. / la=0.1 mm. }

[17] From διπλόος, double + τρῆσις, perforation; referring to the two frontal pores.

Variations.—The micrometric variations are great, especially in the vicinity of the ancestrula, which is here a small ordinary zooecium measuring only 0.2 mm in length.

The zooeciules are still more variable, for there are long ones measuring 0.5 mm and small examples scarcely 0.2 mm in length. They are almost always oriented distally, but there are some cases of curious and unexpected inversions. They are generally isolated, although sometimes there are groups of 3 to 6 adjacent zooeciules; on other parts of the colony they form small linear series of 3 to 4 successive zooeciules.

Many of the zooecia are covered by a second incomplete pellicle in structure analogous to that of the primitive frontal. The two frontal pores are difficult to discern, for they disappear frequently in fossilization. It is necessary to tint the specimens blue in order to discover them more easily.

Among the Cretaceous fossils, the species of the Cribrimorph group of *Distansescharella* D'Orbigny, 1852, have an aspect close to that of the Hippothoidae. Their differentiation is difficult and is a constant source of error of determination.

It is possible to recognize perhaps in the genus *Diplotresis* the ancestor of the Tertiary–Recent genus *Haplopoma* Levinsen, 1909, in which the ascopore is simple, both of them being derivatives of Cribrimorph ancestors.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J., and 2 miles southwest of Odessa, Del.

Holotype.—U.S.N.M. No. 52607.

Family ACROPORIDAE Canu, 1913

Genus BEISSELINA Canu, 1913

BEISSELINA LABIATA Gabb and Horn, 1862

PLATE 19, FIGURES 7–13

1862. *Crescis labiata* GABB and HORN, Journ. Acad. Nat. Sci., Philadelphia, ser. 2, vol. 5, p. 177, pl. 21, fig. 69.

1907. *Porina labiata* ULRICH and BASSLER, *in* Weller, Geol. Survey New Jersey, Paleontology, vol. 4, p. 350, pl. 26, figs. 1–6 (bibliography).

1920. *Beisselina labiata* CANU and BASSLER, U.S. Nat. Mus. Bull. 106, p. 324, pl. 7, fig. 14.

Description.—The zoarium is free, bilamellar, formed of two opposed inseparable lamellae; the branches are compressed, rather wide, dichotomous, elliptical in cross section; the base is attached to other free Bryozoa. The zooecia are indistinct, elongated, arranged in quincunx; the frontal is hidden under the avicularia visible exteriorly; it bears a large ascopore, little removed from the aperture and opening in the interior of the zooecium below the oper-

culum. The apertura is suborbicular and hidden at the bottom of a long peristomie; the latter is formed by the frontal avicularia in which the walls are much thickened and by a thick and salient peristome; the peristomice is orbicular.

The ovicell is hidden under the frontal avicularia, resting on the distal zooecium and opening below the operculum. Each frontal is covered by at least 3 small avicularia with thick walls; 1 is proximal and the other 2 are lateral and open in the vicinity of the peristomices of the adjacent zooecia. Their orifice is small, orbicular without a pivot. Frequently the small proximal avicularium is much developed to form a large avicularium covering all the frontal; it has a pivot, and its beak is rounded and very salient above the zoarial plane.

Measurements.—

Zooecia $\begin{cases} Lz = 0.5 \text{ mm.} \\ lz = 0.2\text{–}0.25\ (?) \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hp = 0.1 \text{ mm.} \\ lp = 0.1 \text{ mm.} \end{cases}$

8 zooecia in 1 sq. mm.

Structure.—A well-prepared longitudinal thin section reveals admirably the structure of this species in particular and of the genus in general. The zooecial walls are thin, but the walls of the small frontal avicularia, on the contrary, are very thick. The latter form the thick carapace that surrounds the colony. There are 2 or 3 on each zooecium. The more inferior (the proximal one of our description) is attached to the peristomie of the proximal zooecium and appears to have budded from the latter; its size is variable and it can transform itself into a large frontal avicularium. The large avicularium is a special heterozooecium covering a normal zooecium and arising like it from the proximal zooecium; a septule (seen in section) communicates with the subjacent zooecium.

The ascopore opens in the interior of the zooecium in the close vicinity of the aperture; it is somewhat curved.

The ovicell is almost endozooecial, resting somewhat on the distal zooecium, covered by the proximal avicularium of the distal zooecium and opening into the same zooecium. The larvae must then have traversed the entire peristomie before escaping into the water, and we can well suppose that the function of the small avicularia surrounding each peristomice is to drive them away and to prevent them from attaching themselves to the colony.

Variations.—No fixed rule appears to operate in the distribution of the small frontal avicularia. Normally each peristomice is surrounded distally by 3 small avicularia, 1 developed on the distal zooecium and the other 2 on the adjacent zooecia; a fourth arising from the same zooecium is sometimes added between the peristomice

and the ascopore. But the irregularities of gemmation and of calcification much derange this fundamental arrangement, and one can see there only a deceptive irregularity, which, however, can be understood by close study.

The peristomice is frequently elliptical and transverse. On the edge of the zoarial branches the ascopores are much larger, and their diameter frequently attains that of the peristomices themselves.

Affinities.—Of the three species of *Beisselina* with similar exterior aspect discovered in the Vincentown limesand, this one is the smallest in its micrometric dimensions. It is also the most irregular, and finally it never shows a peristomice entirely surrounded by at least four avicularia. Gabb and Horn's figure does not show salient peristomices regularly surrounded by avicularia, so that Ulrich and Bassler's determination of 1907 is exact.

Occurrence.—Vincentown limesand: Mullica Hill and Timber Creek, N.J. (Gabb and Horn); common at Vincentown and near Blackwoodstown, N.J.

Plesiotypes.—U.S.N.M. No. 73936.

BEISSELINA INTERMEDIA, new species

PLATE 18, FIGURES 2, 3

Description.—The zoarium is free, bilamellar, formed of two lamellae opposed and inseparable; the fronds are wide, thick, elliptical in cross section, bifurcated in the same plane. The zooecia are indistinct, elongated, arranged in quincunx; the frontal is buried under the avicularia visible exteriorly; it bears an ascopore at some distance from the peristomice and opening into the interior of the zooecium below the operculum. The aperture is buried at the bottom of a long oblique peristomie; the latter is formed by frontal avicularia, which have very thick walls, by a salient peristome, and by the peristomial avicularia; the peristomice is orbicular with a diameter intermediate between that of *B. lonsdalei* and *B. labiata*, surrounded by 4 to 6 small, salient avicularia with or without a pivot and arranged like a crown. Each frontal is covered by 3 to 5 small, thick-walled avicularia irregularly arranged, in which the orifice is small and without a pivot. Frequently the small proximal avicularium develops so much that it becomes a large avicularium covering all the frontal; it is triangular with pivot; its beak is pointed and salient above the zoarial plane.

Measurements.—

Zooecia $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.3 \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hp = 0.125 \text{ mm.} \\ lp = 0.125 \text{ mm.} \end{cases}$

21 or 22 zooecia in 4 sq. mm.

Affinities.—It appears to us that the ovicell must have opened into the peristomice, but we have not been able to make a thin section confirming this. The species differs from *B. lonsdalei* in its smaller micrometric dimensions and in the more salient, large triangular avicularium. It differs from *B. labiata* Gabb and Horn, 1862, in its larger micrometric dimensions and in the presence of a crown of small avicularia around its peristomice.

Occurrence.—Vincentown limesand: Rare at Vincentown, N.J.

Cotypes.—U.S.N.M. No. 73938.

BEISSELINA MORTONI, new species

PLATE 19, FIGURES 1–6

1907. *Porina quadrangularis* (GABB and HORN?) ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 350, pl. 26, fig. 7 (not 8).

Description.—The zoarium is free, bilamellar; the fronds are narrow, subcylindrical or somewhat compressed, with subcircular or elliptical cross section, bifurcated. The zooecia are indistinct, elongated, arranged in quincunx, with 4 to 6 longitudinal rows to a branch; the frontal is covered by 6 avicularia with thick and slightly granulose walls, visible exteriorly; it bears an ascopore some distance from the peristomice and opening into the interior of the zooecium below the operculum. The apertura is buried at the bottom of an oblique peristomie formed by the thickening of the frontal avicularia. The peristomice is semielliptical, transverse, and bears an avicularian mucron on its proximal lip. Each frontal is covered by six small avicularia with small poriform orifice. The distal one is salient and forms the avicularian mucron; 2 others, laterally arranged, are symmetrically placed above the ascopore; 2 other lateral ones are symmetrically located below the ascopore and in the vicinity of the peristomice of the adjacent zooecia; the last is proximal and opens above the proximal peristomice. Sporadically the latter develops a large triangular avicularium in which the beak is very salient above the zoarial plane.

Measurements.—

Zooecium $\begin{cases} Lz = 0.34\text{–}0.6 \text{ mm.} \\ lz = 0.36\ (?) \text{ mm.} \end{cases}$ Peristomice $\begin{cases} hp = 0.07 \text{ mm.} \\ lp = 0.11\text{–}0.13 \text{ mm.} \end{cases}$

4 zooecia in 1 sq. mm.

Structure.—In longitudinal sections the structure is absolutely analogous to that of other species of *Beisselina*, but the avicularian walls are not so thick. The ascopore, often closed over by fossilization, is here quite visible, and the large avicularium can be observed, as in *B. labiata* Gabb and Horn, 1862.

Variations.—The avicularium of the proximal umbo is the larger; it bears a pivot and is oriented distally or obliquely; its beak is tri-

angular and acuminated. On the short zooecia the two lateral avicularia placed above the ascopore unite to the preceding and form a 3-pored lip on the peristomice. When the proximal avicularium is transformed into a large frontal one, the two small lateral avicularia placed below the ascopore disappear. Thus the symmetrical arrangement of the avicularia is frequently deranged.

The diameter of the branches varies from 0.5 mm to 1 mm.

Affinities.—Ulrich and Bassler, 1907, believed that this species represented Gabb and Horn's *Entalophora quadrangularis* (see pl. 10, p. 58) upon the assumption that their figure, although quite different, could if based on a Vincentown species, apply only to this one. Since the discovery of *Ochetosella jacksonica* Canu and Bassler, 1917, in the Eocene (Jacksonian) of the Atlantic and Southern States they are convinced that Gabb and Horn more likely had an example of that species before them. *Beisselina mortoni* is well characterized by the avicularian mucron, which is very constant. It differs from *B. mucronata* Canu, 1929, from the French Maastrichtian in its shorter zooecia and in the presence of 6 instead of 3 frontal avicularia.

Occurrence.—Vincentown limesand: Rare at Vincentown and near Blackwoodstown, N.J.

Cotypes.—U.S.N.M. No. 52614.

BEISSELINA LONSDALEI, new species

PLATE 18, FIGURE 4

1907. *Acropora coronata* (not REUSS) ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 351, pl. 26, fig. 11.

Description.—The zoarium is large, free, bilamellar with the lamellae placed back to back, opposed, and inseparable; the fronds are wide, thick, elliptical in section, branching dichotomously on the same plane. The zooecia are indistinct, elongated, arranged in quincunx; the frontal is hidden under the avicularia exteriorly visible; it bears an ascopore at some distance from the aperture and opening in the interior of the zooecium below the operculum. The aperture is subcircular and hidden at the bottom of a long, little oblique peristomie; the latter is formed by the frontal avicularia in which the walls are very thick, by a salient peristome, and by the peristomial avicularia; the peristomice is orbicular, large, surrounded by 4 or 5 small avicularia with or without a pivot and arranged crown-like. The ovicell is hidden under the frontal avicularia. Each frontal is covered by four to eight small avicularia with very thick walls, without pivot and irregularly arranged. Frequently the small proximal avicularium develops so much that it forms a large special avicularium covering the entire frontal; it has a pivot, is

spatulate or semielliptic; its beak is rounded and salient above the zoarial plane.

Measurements.—

Peristomice $\begin{cases} hp = 0.13–0.16 \text{ mm.} \\ lp = 0.13–0.16 \text{ mm.} \end{cases}$ Zooecium $\begin{cases} Lz = 0.72–0.75 \text{ mm.} \\ lz = 0.36\ (?) \text{ mm.} \end{cases}$

18 zooecia in 4 sq. mm.

Structure.—The structure is identical with that of *B. labiata* Gabb and Horn, 1862, as confirmed by sections. Around each peristomice there is a crown of five small salient avicularia, which give to the ensemble the aspect of *Porina coronata* Reuss, 1869. This arrangement is frequent in many of the species of the Acroporidae and is not peculiar to *Acropora* Reuss, 1869. A remarkable fact is that the ascopore opens always in the immediate vicinity of the large avicularium and even perforates its cryptocyst; the mandible, in opening, touches the ascopore and closes it.

The hydrostatic function of this large avicularium here appears perfectly evident, namely, its mandible closes in order to open the ascopore, thus permitting the water to enter the compensatrix, opening the operculum and permitting the tentacles to emerge. But we do not understand why the other cells are not likewise equipped.

Affinities.—In spite of the exterior aspect this species does not belong to *Acropora*, for its zoarial walls are formed of avicularia and not of tubes, and the large avicularium is proximal and not placed between the ascopore and the peristomice. The latter characters are essentially those of the genus *Beisselina* Canu, 1918. We cannot retain the specific name *coronata* because there already exists *Beisselina coronata* Hagenow, 1851, from the Maastrichtian of Limbourg, so we propose the new designation in honor of William Lonsdale, who, among other activities, was a pioneer student of American post-Paleozoic Bryozoa.

Biology.—Canu, 1918, believed that the numerous species of *Beisselina* in the Danian and Maastrichtian epochs indicated agitated waters and strong currents. This was an error, as the avicularia on the contrary multiply their number and their size in deep and calm waters. In order to construct such large colonies these small animals had need of considerable quantities of nourishment (diatoms). In order to obtain such food it is absolutely necessary that the water be constantly renewed, which is precisely the function of the numerous avicularia. We suppose also that the large avicularia arranged in linear series had the mandibles for a simultaneous movement and destined to create a slight current over the zoarial surface.

Occurrence.—Vincentown limesand: Rare at Vincentown and near Blackwoodstown, N.J.

Holotype.—U.S.N.M. No. 52613.

Family ESCHARELLIDAE Levinsen, 1909

Subfamily PERISTOMELLAE Canu and Bassler, 1917

Genus EXOCHELLA Jullien, 1888

EXOCHELLA SEPTENTRIONALIS, new species

PLATE 17, FIGURES 2–5

1907. *Mucronella pumila* (part) ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 355, pl. 26, fig. 16.

Description.—The zoarium encrusts *Coscinopleura*, fragments of sea-urchins, and shells; it is small. The zooecia are distinct, separated by a thin thread placed at the bottom of a deep furrow, little elongated, swollen, ensiform; the frontal is convex, smooth, bordered by some small areolar pores, little visible, and terminated by a salient mucron, which is erect, flat, wide, bifid, and hiding the aperture. The aperture is semielliptical, transverse, little visible, concealed at the bottom of the locella; the peristome is thin, little salient, garnished with 2 small distal spines and with 2 lateral ones. The ovicell is hyperstomial, resting on the distal zooecium, widely open in front of the mucron, not closed by the operculum. On each side of the aperture there is a small avicularium with pivot, triangular, oriented distally. The ancestrula is small, membraniporoid or not.

Measurements.—

Zooecia { Lz=0.45 mm. / lz=0.36 mm. } Apertura { ha=0.08 mm. / la=0.12–0.15 mm. }

Variations.—The ancestrular zooecia are much smaller than the marginal zooecia and as the zoaria are very small, the number of cells to the square millimeter is quite variable; it is 12 around the ancestrula and 5 or 6 only on the zoarial margins. There are only two avicularia on the wide marginal and ovicelled zooecia and none at all on the nonovicelled ones. The narrow ovicelled zooecia have only a single avicularium.

The well-developed nonovicelled zooecia have 4 spines, but the ancestrular zooecia have only 2. On the ovicelled zooecia the spines are replaced by the avicularia.

The mucron is well developed only on the ovicelled zooecia. On the others it is smaller, less salient, and not bifid.

The ancestrula appears very variable. It is a very small ordinary zooecium without avicularia. However, we have figured a colony on which the ancestrula is reduced to an apertural portion accompanied by four small avicularia.

Affinities.—*Exochella septentrionalis* differs notably from the other species of the genus in the absence of large areolar pores and in the

oral avicularia not placed on the adjacent zooecia. These differences are not of generic order.

All the recent and fossil species hitherto known occur in the temperate zone of the Southern Hemisphere. So it is interesting to note the extension of the genus in the warm zones of the Northern Hemisphere. Canu, 1911, described two species from the Rocaneen of Argentina, which is a horizon about equivalent to that of the Vincentown limesand. *Lepralia* (*Mucronella*) *neumayri* Pergens, 1893, from the Maastrichtian of Limbourg, appears also to be an *Exochella*. The figured specimen is not very good, but the author states that the inferior part of the orifice bears in the middle a denticulated prominence. If we are not mistaken, the genus *Exochella* begins then in the Maastrichtian.

Biology.—This species of *Exochella* is organized to assure reproduction. The ovicelled zooecia are numerous; they are accompanied by protective adventitious avicularia and mucron. The colonies are small and of short life; they compensate for their precarious existence by their fertility.

Exochella is the direct ancestor of *Didymosella* Canu and Bassler, 1920, by the fusion of the mucron with the proximal spines. The latter genus remains purely equatorial and limited to warm waters.

Occurrence.—Vincentown limesand: Not uncommon at Vincentown and near Blackwoodstown, N.J., and at Noxontown Millpond and 2 miles southwest of Odessa, Del.

Cotypes.—U.S.N.M. Nos. 73886, 73887.

Family PHYLACTELLIDAE Canu and Bassler, 1917

Genus PERIGASTRELLA Canu and Bassler, 1917

PERIGASTRELLA EXSERTA Gabb and Horn, 1862

PLATE 20, FIGURES 1–3

1862. *Cellepora exserta*, GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 125, pl. 19, fig. 6.

1907. *Monoporella exserta* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 349, pl. 25, fig. 567 (bibliography).

Description.—The zoarium encrusts *Coscinopleura* and the debris of shells. The zooecia are distinct, separated by a deep furrow, large, little elongated, swollen, oval or barrel shaped; the frontal is convex, ornamented with small transparent granulations and surrounded by small, scattered, areolar pores. The apertura is suborbicular and placed at the bottom of a short peristomie; the peristome is salient, thick, and fringed. The ovicell is recumbent, small, globular, opening exteriorly or into the peristomie. Small dietellae are present.

Measurements.—

Zooecium $\begin{cases} Lz = 0.75 \text{ mm.} \\ lz = 0.6\text{–}0.7 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.14 \text{ mm.} \\ la = 0.12\text{–}0.14 \text{ mm.} \end{cases}$

12 zooecia in 4 sq. mm.

Variations.—The frontal and the ovicell are frequently covered by a second pellicle identical with the first which may be totally or partially developed.

Occurrence.—Vincentown limesand: Mullica Hill, N.J. (Gabb and Horn); not uncommon at Vincentown, N.J.; rare at Noxontown Millpond, Del.

Plesiotype.—U.S.N.M. No. 52608.

Family HIPPOPODINIDAE Levinsen, 1909

Genus HIPPALIOSINA Canu, 1918

HIPPALIOSINA ASPERA Gabb and Horn, 1862

PLATE 15, FIGURE 1

1862. *Reptoecelleporaria aspera* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 131, pl. 19, fig. 14.

1901. *Lepralia subplana* ULRICH, Maryland Geol. Surv., Eocene, vol. 1, p. 219, pl. 59, fig. 17.

1907. *Lepralia aspera* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 352, pl. 26, fig. 9 (bibliography).

1920. *Meniscopora subplana* CANU and BASSLER, U.S.Nat.Mus. Bull. 106, p. 556, pl. 2, figs. 4, 5.

Description.—The zoarium is creeping, multilamellar, surrounding small fragments and pebbles. The lamellae are superposed. The zooecia are distinct, separated by a shallow furrow or by a thread, small, little elongated, oval or elliptical; the frontal is a pleurocyst reposing on a nonperforated olocyst; it is granulose, decorated with false tremopores, and surrounded by rather large areolar pores. The aperture is semielliptic, a little elongated with a proximal border somewhat concave; the peristome is complete, very little salient, often worn. The ovicell is endozooecial, narrow, somewhat convex, smooth, little visible. On each side of the aperture there is a small triangular avicularium, oblique, oriented distally toward the longitudinal median axis of the zooecium. Distal dietellae present.

Measurements.—

Zooecium $\begin{cases} Lz = 0.5\text{–}0.54 \text{ mm.} \\ lz = 0.36\text{–}0.45 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.144 \text{ mm.} \\ la = 0.126 \text{ mm.} \end{cases}$

30–35 zooecia in 4 sq. mm.

Structure and variations.—The aspect of the frontal is quite variable, the calcification being very irregular; it is frequently covered by false tremopores absolutely invisible on the interior of the zooecium where the nonperforated olocyst alone is visible.

The areolar pores do not surround the frontal only, for they occur also around the distal portion of the peristome. By abrading the surface, it can be observed that the distal half of each zooecium is surrounded by dietellae; these correspond to the distal areolar pores.

The largest colony observed measures 3 cm in length and contains five superposed lamellae. As it surrounds some fragment that rested on the sea bottom, sedimentation must have been very slow.

Affinities.—The appearance in the Vincentown limesand of this Recent equatorial genus is quite remarkable. The general structure of the cheilostomatous Bryozoa is already quite complicated in the Upper Cretaceous, but the simpler forms are more abundant while others are very rare. We note finally that this genus still exists in the Gulf of Mexico.

Hippaliosina aspera differs from the other known species in the smallness of its avicularia and of its ovicells.

The geographic distribution of the species of a genus of cheilostomatous Bryozoa is controlled by capricious biologic conditions. Thus we note that *Hippaliosina*, arising in the Vincentown limesand of America, is absent from this country during the Eocene and Oligocene but reappears in the Upper Miocene and persists in the Gulf of Mexico. In Europe, on the contrary, it appeared in the Eocene, persisted through the Oligocene and the Miocene, and disappeared during the Pliocene.

The species of *Hippaliosina* are of shallow water, 30 to 50 meters deep, but while they are known to ascend to a greater depth and endure a temperature of 12° to 25° C. in the equatorial zone, they cannot do this in another zone. Also by the aid of these species, Canu, 1918, has shown that the contraction of the tropical zone in the geologic series can be followed.

Occurrence.—Vincentown limesand: Timber Creek and Mullica Hill, N.J. (Gabb and Horn); rare at Vincentown and near Blackwoodstown, N.J., and and at Noxontown Millpond, Del. Eocene (Aquia): Upper Marlboro, Md.

Plesiotypes.—U.S.N.M. No. 73912.

Family RETEPORIDAE Smitt, 1867

PSILOSECOS,[18] new genus

Reteporidae(?) in which the ovicell is hyperstomial, closed by the operculum. The frontal is smooth and bears two to four sublateral pores. The apertura is lepraliform provided with a mucron transformed into a lyrula and with a distal peristomial avicularium.

[18] From ψιλός, bare + σηκός, small case; referring to the aspect of the frontal.

Genotype.—Psilosecos (*Escharinella*) *muralis* Gabb and Horn, 1862.

This new genus is created for the reception of two species appearing in the European Danian and in the supposed American equivalent:

Monoporella angustidens Levinsen, 1925 ..... Faxe.
Escharinella muralis Gabb and Horn, 1862 ..... Vincentown.

Levinsen, 1925, interpreted the frontal pores as derived from avicularia. They can also be interpreted as areolar pores. In the genera *Malleatia* Jullien, 1903, and *Hippoclozoon* Canu and Bassler, 1923, of the Reteporidae, there are species with cells exhibiting an analogous aspect in having also very small frontal pores and a lyrula. We are therefore classifying this genus in the Reteporidae doubtfully.

PSILOSECOS MURALIS Gabb and Horn, 1862

PLATE 15, FIGURES 2–7

1862. *Escharinella muralis* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 140, pl. 19, fig. 23.
1907. *Mucronella muralis* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 352, pl. 26, fig. 10 (bibliography).

Description.—The zoarium is composed of flattened, rather narrow, irregularly dividing branches, with from 4 to 8 rows of zooecia upon each side. The zooecia are distinct, separated by a salient sinuous thread, elongated, oval or fusiform; the frontal is little convex, smooth, perforated sublaterally by 2 to 4 round or rectilinear pores; it bears proximally an elliptical avicularium with a pivot oriented in the interior of the aperture of the proximal zooecium. The aperture is elliptical, elongated, and bears on its proximal lip a mucron transformed rapidly into a small rectangular lyrule. The ovicell is hyperstomial, closed by the operculum, completely embedded into the thick wall of the distal zooecium, invisible exteriorly.

Measurements.—

Zooecium { Lz=0.6–0.7 mm. / lz=0.35 mm. } Apertura { ha=0.12 mm. / la=0.1 mm. }

Variations.—Gabb and Horn's figure illustrates one of the many variations of this species. These are caused by the vigorous epicalcification of the frontal aided by the presence of separating threads. When the zooecial walls are very thick the threads become thinner and even invisible, whereupon the frontal is very convex. Simultaneously, the distal avicularium, salient on the young zooecia, becomes embedded in the aperture and is not visible on the old zooecia of the same zoarium. The primitive frontal pores always persist and are obliterated only by fossilization.

Structure.—The longitudinal section shows thick frontal walls. The ovicell is buried in the interior, and since it is placed below the distal avicularium it is wholly invisible exteriorly. The ovicell is thus visible only in thin sections. There is no peristome on the young zooecia, but on the old cells there is one formed by the thickening of the frontal walls.

The two lamellae of the zoarium are inseparable, and the zooecia of each of these are placed exactly in front of the zooecia of the other lamella. This symmetrical arrangement is perfect.

The transverse section is elliptical, and there are no zooecia along the edges of the zoarial branches.

Affinities.—The presence of the lyrule seems to indicate that this species belongs to the Smittinidae, for which reason Ulrich and Bassler, 1907, referred it to *Mucronella* Hincks, 1877. But in this genus the ovicell is not closed by the operculum and the ovicell is not hidden. We prefer, however, to classify *Psilosecos* in the Reteporidae for the reasons just given.

Monoporella angustidens Levinsen, 1925, from the Danian of Faxe has been well studied by its author. It is smaller and rarer and we prefer to choose the American species as the genotype because it is more abundant, larger, and its interior structure is known.

Acanthionella oecioporosa Canu and Bassler, 1920, from the Claibornian of Alabama seems to belong to this new genus.

Occurrence.—Vincentown limesand: Mullica Hill, N.J. (Gabb and Horn); not uncommon at Vincentown and near Blackwoodstown, N.J.

Plesiotypes.—U.S.N.M. No. 73902.

Family CELLEPORIDAE Busk, 1852

Genus ACANTHIONELLA Canu and Bassler, 1917

ACANTHIONELLA TYPICA Gabb and Horn, 1860

PLATE 16, FIGURES 1–7

1860. *Cellepora typica* GABB and HORN, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, p. 366.

1907. *Mucronella typica* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 353, pl. 26, figs. 12, 13 (bibliography).

1907. *Mucronella aspera* (part) ULRICH and BASSLER, *in* Weller, *ibid.*, p. 355 (not pl. 26, figs. 14, 15).

Description.—The young zoarium encrusts the debris of shells and *Coscinopleura;* it develops next into free compressed branches more or less wide, dichotomous, formed of two lamellae placed back to back, inseparable. The young zooecia are distinct, separated by a furrow, elongated, oval, capitate; the frontal is convex, smooth.

The aperture is terminal, semielliptic, lepraliform; the proximal lip is straight and bears a small salient mucron transformed rapidly into a true lyrule; the peristome is distal, thin, little salient. The ovicell is hyperstomial not closed by the operculum, widely open, smooth, convex, salient. On each side of the aperture there is a small elliptical avicularium with a pivot, divergent, oblique or transverse, oriented proximally. The adult zooecia are indistinct; the frontal is covered by an epicalcification and with one or two small supplementary avicularia; the apertura is deeply embedded at the bottom of the short peristomie formed by the epicalcification; the ovicell is little salient, little visible, surrounded by epicalcification, opening widely into the peristome. The ancestrula is a very small ordinary zooecium without avicularia. Sporadically there is a very large avicularium replacing a zooecium; it is elliptical, or oval, somewhat spatulate, with a pivot.

Measurements.—

Zooecium $\begin{cases} Lz = 0.63\text{–}0.72 \text{ mm.} \\ lz = 0.29\text{–}0.36 \text{ mm.} \end{cases}$ Apertura $\begin{cases} ha = 0.14\text{–}0.16 \text{ mm.} \\ la = 0.13 \text{ mm.} \end{cases}$

Avicularium $\begin{cases} Lav = 0.63 \text{ mm.} \\ lav = 0.31 \text{ mm.} \end{cases}$ Orifice $\begin{cases} hav = 0.36 \text{ mm.} \\ lav = 0.18 \text{ mm.} \end{cases}$

24–26 zooecia in 4 sq. mm.

Variations.—The variations of this species are considerable, for there is a great difference between the ancestrular zooecia, the young marginal zooecia, and the more numerous adult zooecia.

The ancestrular zooecia are rarely provided with avicularia; they bear a pointed mucron and not a lyrule; they are sometimes surmounted by a large globular ovicell.

The young marginal zooecia rarely occupy a large portion of the branches; they are rather regular in their ensemble, but nevertheless the place and the orientation of the small avicularia are not constant; the ovicell is less salient than on the ancestrular zooecia.

On the other zooecia the frontal epicalcification much deranges the place of the primitive avicularia by the addition of pores of calcification and by a row of avicularia. The general aspect is then of a disconcerting irregularity, which recalls that in *Beisselina*. By noting especially the two more or less deranged primitive avicularia it is easy to discover the new avicularia.

The function of the zooecial avicularia is difficult to discover because of their irregularity. We suppose it to be the usual one of oxygenation by the renewal of the adjacent water.

The waters of the Vincentown deposits were certainly calm and rich in diatoms, permitting the rapid and easy development of vigorous species with much calcified zoaria.

Affinities.—*Acanthionella typica* is the type of the genus as chosen by Canu and Bassler in 1917, so that it is with it that other species should be compared. The genus is not exclusively American, for to the known species must be added *Lepralia* (*Mucronella*) *russelli* Pergens, 1893, from the Maastrichtian of Limbourg.

Eschara striata Goldfuss, 1826, from the Maastrichtian of Limbourg was classed by Voigt, 1930, in *Kleidionella*, but this species bears an ascopore, which structure is lacking in that genus.

Ulrich and Bassler, 1907, considered the encrusting specimens as belonging to *Mucronella aspera* Ulrich, 1907, from the Eocene at Upper Marlboro, Md., but now that encrusting specimens with bilamellar expansions have been discovered they no longer maintain this opinion.

We made the first study in 1920 of the genus *Acanthionella*. The section of this species published by us in 1920, made from a very calcified specimen, shows clearly that the ovicell is not closed by the operculum, so that the genus is quite distinct from *Psilosecos*. However, it is unquestionable that the two genera are closely related, and in the future they may be placed in a new family close to the Reteporidae and Smittinidae.

Occurrence.—Vincentown limesand: Timber Creek and Mullica Hill, N.J. (Gabb and Horn); common at Vincentown and near Blackwoodstown, N.J.; rare at Noxontown Millpond and 2 miles southeast of Odessa, Del.

Plesiotypes.—U.S.N.M. Nos. 73895, 73896.

Genus KLEIDIONELLA Canu and Bassler, 1917

KLEIDIONELLA(?) TRABECULIFERA, new species

PLATE 15, FIGURE 8

Description.—The zoarium is bilamellar. The zooecia are indistinct, unoriented, urceolate in appearance; they are surmounted by a very thick peristomie erect or oblique; the frontal is convex, smooth, more or less visible. The peristomies are bound together by trabeculae, leaving between them large irregular and polygonal spaces. The apertura is semielliptical, transverse; the proximal border bears a salient triangular mucron, the peristome bears two small avicularia arranged laterally and symmetrically. The large interzooecial avicularia are oval, with denticles, spatulate or not.

Measurements.—

Apertura { *ha*=0.1 mm. Diameter of peristomie, 0.2–0.25 mm.
la=0.14 mm. 18–20 zooecia in 4 sq. mm.

Variations.—It is difficult to estimate the number of zooecia on a given surface because of the great irregularity of the polygonal

spaces between the trabeculae, in which the large avicularia often appear to lodge.

Besides the large avicularia described above, there are others in which the orifice is different and provided with an inferior sinus more or less deep. The rarity of specimens has made it impossible to study in detail and to determine its true structure.

Voigt, 1930, discovered in the Danian of Faxe a species, *Kleidionella celleporoides*, that presents some analogies with *K. trabeculifera*, but that does not bear trabeculae.

Occurrence.—Vincentown limesand: Very rare at Vincentown, N.J.

Holotype.—U.S.N.M. No. 73894.

Order CYCLOSTOMATA Busk

Subdivision PARALLELATA Waters, 1887

Family DIASTOPORIDAE Gregory, 1899

STOMATOPORA REGULARIS Gabb and Horn, 1862

1862. *Stomatopora regularis* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 172, pl. 21, fig. 64.—ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 313, pl. 20, figs. 1–3 (bibliography), 1907.

Occurrence.—Vincentown marl: Vincentown and near Blackwoodstown, N.J.; Noxontown Millpond, Del.

STOMATOPORA KÜMMELLI Ulrich and Bassler, 1907

1907. *Stomatopora kümmelli* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 314, pl. 20, fig. 4.

Occurrence.—Vincentown limesand: Vincentown and near Blackwoodstown, N.J.

ENTALOPHORA CONRADII Gabb and Horn, 1862

1862. *Entalophora conradii* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 170, pl. 21, fig. 59.—ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 323, pl. 22, fig. 9 (bibliography), 1907.

Occurrence.—Vincentown limesand: Mullica Hill, Vincentown, and near Blackwoodstown, N.J.

RETELEA OVALIS Gabb and Horn, 1862

1862. *Retelea ovalis* GABB and HORN, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 164, pl. 21, fig. 52.—ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 328, pl. 23, figs. 3, 4 (bibliography), 1907.

Occurrence.—Vincentown limesand: Near Mullica Hill, Vincentown, and near Blackwoodstown, N.J.; Noxontown Millpond, Del.

Family ONCOUSOECIIDAE Canu, 1918

ONCOUSOECIA CONTORTILIS Lonsdale, 1845

1845. *Idmonea contortilis* Lonsdale, Quart. Journ. Geol. Sci. London, vol. 1, p. 68, pl. 11 a–d.—Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 167, 1862.

1907. *Filisparsa contortilis* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 322, pl. 22, figs. 5–7 (bibliography).

Occurrence.—Vincentown limesand: Timber Creek, Vincentown, and near Blackwoodstown, N.J.

ONCOUSOECIA BIFURCATA Ulrich and Bassler, 1907

1907. *Filisparsa bifurcata* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 322, pl. 22, fig. 8.

1922. *Oncousoecia bifurcata* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 6, pl. 1, fig. 1.

Occurrence.—Vincentown limesand: Vincentown and near Blackwoodstown, N.J.

Family PLAGIOECIIDAE Canu, 1918

PLAGIOECIA AMERICANA Ulrich and Bassler, 1907

1907. *Berenicea americana* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 315, pl. 20, fig. 7.

1922. *Plagioecia americana* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 27, pl. 3, fig. 3. fig. 13–15.

Occurrence.—Vincentown limesand: Vincentown and near Blackwoodstown, N.J.; Noxontown Millpond, Del.

PLAGIOECIA VARIANS Ulrich, 1901

1901. *Discosparsa varians* Ulrich, Maryland Geol. Surv., Eocene, vol. 1, p. 205, pl. 59, fig. 3.—Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 315. pl. 21, figs. 1, 2, 1907.

1920. *Diaperoecia varians* Canu and Bassler, U.S.Nat.Mus. Bull. 106, p. 741, pl. 104, figs. 1–4.

1922. *Plagioecia varians* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 26, pl. 3, fig. 12.

Occurrence.—Lowest Eocene (Bryozoan bed near base of Aquia formation): Upper Marlboro, Md. Vincentown marl: Vincentown and near Blackwoodstown, N.J.

STATHMEPORA GABBIANA Ulrich and Bassler, 1907

1907. *Bisidmonca gabbiana* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 320, pl. 22, figs. 1, 2.

1922. *Stathmepora gabbiana* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 39, pl. 7, figs. 4, 5.

Occurrence.—Vincentown limesand: Vincentown and near Blackwoodstown, N.J.

Family DIAPEROECIIDAE Canu, 1918

DIAPEROECIA AMERICANA Gabb and Horn, 1862

1862. *Fascipora americana* Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 165, pl. 21, fig. 54.
1907. *Clausa americana* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 325, pl. 22, fig. 11 (bibliography).
1922. *Diaperoecia americana* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 46, pl. 9, figs. 6–10.
1901. *Fascipora subramosa* Ulrich, Eocene vol., Maryland Geol. Surv., p. 207, pl. 59, figs. 1, 2.

Occurrence.—Vincentown limesand: Timber Creek, near Mullica Hill, Vincentown, and near Blackwoodstown, N.J.

DIAPEROECIA SAILLANS Canu and Bassler, 1922

1922. *Diaperoecia saillans* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 43, pl. 8, fig. 12.

Occurrence.—Vincentown limesand: Vincentown, N.J.

DIPLOSOLEN LINEATUM Gabb and Horn, 1862

1862. *Diastopora lineata* Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 172, pl. 21, fig. 62.—Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 316, pl. 21, figs. 3, 4 (bibliography), 1907.
1922. *Diplosolen lineatum* Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 47, pl. 9, fig. 20.

Occurrence.—Vincentown limesand: Timber Creek, Mullica Hill, Vincentown, and near Blackwoodstown, N.J.

LEKYTHIONIA DICHOTOMA Gabb and Horn, 1862

1862. *Reticulipora dichotoma* Gabb and Horn, Journ. Acad. Nat. Sci., Philadelphia, ser. 2, vol. 5, p. 173, pl. 21, fig. 64.—Ulrich, Maryland Geol. Surv., Eocene vol., p. 207, pl. 50, figs. 9–12, 1901.—Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 318, pl. 21, figs. 5–14 (bibliography), 1907.
1920. *Lekythionia dichotoma* Canu and Bassler, U.S.Nat.Mus. Bull. 106, p. 747, pl. 104, figs. 7–13.

Occurrence.—Vincentown limesand: Timber Creek, Vincentown, and near Blackwoodstown, N.J. Eocene (Bryozoan bed near base of Aquia formation): Upper Marlboro, Md.

Family TUBULIPORIDAE Johnston, 1838

IDMONEA (HETEROCRISINA) ABBOTTI Gabb and Horn, 1860

1860. *Heterocrisina abbottii* Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 404, pl. 69, figs. 45–47.
1862. *Bicrisina abbottii* Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 174, pl. 21, fig. 65.

1907. *Idmonea abbotti* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 321, pl. 22, figs. 3, 4 (bibliography).

Occurrence.—Vincentown limesand: Near Mullica Hill, Vincentown, and near Blackwoodstown, N.J.

Family FRONDIPORIDAE Busk, 1875

FILIFASCIGERA MEGAERA Lonsdale, 1845

1845. *Tubulipora megaera* Lonsdale, Quart. Journ. Geol. Soc. London, vol. 1, p. 69, figs. a, b.

1862. *Filifascigera megaera* Gabb and Horn, Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 165, pl. 21, fig. 53.—Ulrich, Zittel-Eastman, Textbook Pal., ed. 1, p. 263, fig. 421, 1896.—Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 325, pl. 22, figs. 12–15 (bibliography), 1907

Occurrence.—Vincentown limesand: Timber Creek, Vincentown, and near Blackwoodstown, N.J., Noxontown Millpond, Del.

Family CYTISIDAE D'Orbigny, 1854

DISCOCYTIS ECCENTRICA Ulrich and Bassler, 1907

1907. *Discocytis eccentrica* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 326, pl. 22, figs. 16–19.—Canu and Bassler, Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 72, pl. 29, fig. 16, 1922.

Occurrence.—Vincentown limesand: Vincentown and near Blackwoodstown, N.J.

Subdivision Rectangulata Waters, 1887

Family LICHENOPORIDAE Smitt, 1866

LICHENOPORA PAPYRACEA D'Orbigny, 1852

1852. *Unitubigera papyracea* D'Orbigny, Paléontologie française, terrains Crétacés, vol. 5, p. 761, pl. 643, figs. 12–14.

1907. *Lichenopora papyracea* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 327, pl. 22, fig. 20.

Occurrence.—Vincentown limesand: Vincentown, N.J.; Noxontown Millpond, Del.

Family LEIOSOECIIDAE Ulrich and Bassler, 1920

LEIOSOECIA PARVICELLA Gabb and Horn, 1860

1860. *Multicrescis parvicella* Gabb and Horn, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, p. 367; Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 401, pl. 69, figs. 36–38, 1860.

1907. *Heteropora parvicella* Ulrich and Bassler, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 327, pl. 23, figs. 1, 2 (bibliography).

1902. *Leiosoccia parvicella* CANU and BASSLER, U.S. Nat. Mus. Bull. 106, p. 824, fig. 273; Proc. U.S.Nat.Mus., vol. 61, art. 22, p. 100, 1922.

Occurrence.—Vincentown limesand: Timber Creek, near Mullica Hill, Vincentown, and near Blackwoodstown, N.J.

DOUBTFUL SPECIES

CELLEPORA TUBULATA Lonsdale, 1845

1845. *Cellepora tubulata* LONSDALE, Quart. Journ. Geol. Soc. London, vol. 1, p. 70.

Occurrence.—Type locality, Lewis Creek, N.C., but cited also from Timber Creek, N.J. The latter specimens are probably *Leiosoecia parvicella* Gabb and Horn, 1860.

CRISINA STRIATOPORA Ulrich and Bassler, 1904

1907. *Crisina striatopora* ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 319 (not Ulrich and Bassler, Miocene Vol. Maryland Geol. Surv., 1904. p. 406, pl. 118, figs. 1–4).

Occurrence.—Miocene of Maryland. Identified at Vincentown, N.J., erroneously.

SPIROPORA CALAMUS Gabb and Horn, 1862

1862. *Spiropora calamus* GABB and HORN, Proc. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 5, p. 166, pl. 21, fig. 55.—ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 324, pl. 22, fig. 10, 1907.

Occurrence.—Vincentown limesand: Timber Creek, N.J. (Gabb and Horn). Type lost and no specimen of this character ever found in the Vincentown collections.

REPTOMULTICAVA CEPULARIS Gabb and Horn, 1860

1860. *Reptomulticava cepularis* GABB and HORN, Proc. Acad. Nat. Sci. Philadelphia, vol. 12, p. 366; Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, p. 401, pl. 69, figs. 33–35; ibid., ser. 2, vol. 5, p. 177, 1862.

Occurrence.—Vincentown limesand: Timber Creek, N.J. Unrecognizable.

RETICULIPORA SAGENA Gabb and Horn, 1860

1860. *Reticulipora sagena* GABB and HORN, Proc. Acad. Nat. Sci. Philadelphia, vol. 12. p. 366; Journ. Acad. Nat. Sci. Philadelphia, ser. 2, vol. 4, 1860, p. 400, pl. 69, figs. 30–32; ibid., ser. 2, vol. 5. p. 173, 1862.—ULRICH and BASSLER, *in* Weller, Geol. Surv. New Jersey, Paleontology, vol. 4, p. 317, 1907.

Occurrence.—Vincentown limesand: Timber Creek, N.J. Species not recognizable.

EXPLANATION OF PLATES

Unless otherwise indicated, all the specimens are magnified × 20, and are from the Vincentown marl, Vincentown, N.J.

Plate 1

Figure 1. *Vincularia acutirostris*, new species (p. 13).
The free vincularform zoarium, showing that the avicularia are interzooecial, lozenge-shaped, and in longitudinal rows.

2, 3. *Membranipora nellioides*, new species (p. 13).
2, A segment terminated by a regenerated cell.
3, Base of a segment with the avicularia intact.

4–7. *Aplousina contumax*, new species (p. 14).
4, Portion of the encrusting zoarium, showing several regenerated zooecia. From near Blackwoodstown, N.J.
5, An ovicelled colony, illustrating also the formation of the distal zooecium and the distal septula. The ovicell is very small and endozooecial. From near Blackwoodstown, N.J.
6, Ancestrular zooecia deformed by an irregularity of the substratum.
7, Complete zoarium, showing the ancestrula with cryptocyst, some regenerated zooecia, the thin basal pellicle, and the orifice of the large distal septula.

8. *Ellisinidra heteropora* Gabb and Horn, 1862 (p. 19).
Encrusting ovicelled specimen, showing the structure of the hyperstomial ovicell and several calcified zooecia.

Plate 2

Figures 1–6. *Aplousina disjuncta* Gabb and Horn, 1862 (p. 15).
1, Surface of the bilamellar zoarium with several ovicelled zooecia.
2, Surface in which incomplete calcification occasioned the total disjunction of several zooecial series.
3, Zooecia showing partial disjunction. One cell is regenerated.
4, Surface with regenerated zooecia, which are here primoserial.
5, Lateral face of the zooecia, illustrating the bilamellar zoarium and showing the uniporous septules.
6, Dorsal side of a free lamella, showing the zooecial disjunction.

7, 8. *Cranosina altimuralis* Ulrich and Bassler, 1907 (p. 17).
7, Ancestrular zooecia of the encrusting zoarium. Here there is a double ancestrula.
8, Regular zooecia of an ovicelled zoarium. The endozooecial ovicell and the small oblique triangular avicularium are shown.

Plate 3

Figures 1, 2. *Membraniporidra perampla* Gabb and Horn, 1862 (p. 18).
1, Portion of the encrusting zoarium, showing four regenerated zooecia and a giant regenerated one.
2, Portion of an ovicelled zoarium. The ovicell is hyperstomial, smooth, and buried in the distal zooecium.

FIGURES 3, 4. *Alderina rustica* D'Orbigny, 1852 (p. 20).

3, Young ovicelled zooecia of the encrusting zoarium. From Noxontown Millpond, Del.

4, Portion of an ovicelled example with large zooecia. The ovicell is hyperstomial and longitudinally carinated.

5–9. *Stamenoecella oculata* Ulrich and Bassler, 1907 (p. 21).

5, A subcylindrical segment preserving the zooecium of the basal articulation, the radicelled zooecia, and those of the normal form.

6, Flabellate bilamellate segment composed entirely of radicular zooecia. From near Blackwoodstown, N.J.

7, Segment exhibiting the basal zooecium of articulation, radicelled and normal zooecia. From near Blackwoodstown, N.J.

8, An example showing the structure of the radicelled zooecia. There is one regenerated zooecium.

9, A flabellate segment showing the very salient lateral avicularia. From near Blackwoodstown, N.J.

PLATE 4

FIGURES 1, 2. *Alderina welleri*, new species (p. 21).

1, Portion of the encrusting zoarium, showing several broken ovicells, two regenerated zooecia, and an inverted giant one.

2, Portion of an ovicelled example. From Noxontown Millpond, Del.

3–5. *Allantopora annuloidea* Ulrich and Bassler, 1907 (p. 25).

3, Portion of the encrusting zoarium with zooecia, showing the gymnocyst.

4, Part of a colony with regenerated zooecia. The structure of the ovicell is visible.

5, An example showing the ancestrula, a small ordinary zooecium.

6. *Allantopora irregularis* Gabb and Horn, 1860 (p. 24).

View of the uniserial, ramified, encrusting zoarium, with several ovicelled zooecia.

PLATE 5

FIGURES 1–3. *Periporosella (?) plebcia* Gabb and Horn, 1862 (p. 25).

1, Portion of the encrusting zoarium in which the ovicells replace the avicularia. Regenerated zooecia are present, and the lateral dietellae are visible. From Noxontown Millpond, Del.

2, An example with small interzooecial avicularia and some zooecia with gymnocyst.

3, The central portion of a zoarium, showing the ancestrula and surrounding zooecia.

4–7. *Crassimarginatella intermedia*, new species (p. 27).

4, Surface of the encrusting zoarium, illustrating the large interzooecial avicularia and ovicelled zooecia and containing many regenerated zooecia.

5, Surface with irregular zooecia and some regenerated ones and (at the base to the right) zooecia inverted without apparent cause.

6, A specimen with regular gemmation. The smooth, carinated, hyperstomial ovicell is well shown.
7, A zoarium with ancestrula. An interzooecial avicularium is regenerated by an ordinary zooecium.

PLATE 6

FIGURES 1, 2. *Crassimarginatella nematoporoides* Ulrich and Bassler, 1907 (p. 28).
Fragments of the narrow subcylindrical zoarium, exhibiting the oval zooecia with spinous mural rim, convex gymnocyst, and beaklike interzooecial avicularium.
3, 4. *Euritina torta* Gabb and Horn, 1862 (p. 33).
3, A narrow example of the free bilamellar zoarium. The deep cryptocyst and fusiform onychocellaria are well developed.
4, Portion of a wide frond with both ordinary and ovicelled zooecia.
5, 6. *Callopora noxontownensis*, new species (p. 30).
Two portions of the type, an encrusting specimen from Noxontown Millpond, Del. The oval, elongated zooecia separated by a deep furrow and bearing four hollow spines are especially characteristic.
7–10. *Callopora jerseyensis* Ulrich and Bassler, 1907 (p. 29).
7, Fragment of the bilamellar zoarium with young zooecia. It shows the calcification of the avicularia and some regenerated zooecia.
8, Another example with some young zooecia. The avicularia are irregularly arranged.
9, An ovicelled specimen; there are four avicularia around each aperture.
10, Cross section showing that the basal lamella is simple and that the two lamellae are inseparable.

PLATE 7

FIGURE 1. *Floridina subscutata*, new species (p. 34).
Portion of the encrusting zoarium. The small zooecia with trifoliate opesium and the onychocellarium with elliptical aperture are shown. From Noxontown Millpond, Del.
2–8. *Amphiblestrum* (?) *abortivum* Gabb and Horn, 1862 (p. 30).
2, Pentagonal claviform fragment, showing the longitudinal series of vibracula.
3, Quadriserial fragment with the vibracula and the structure of the ovicells exhibited.
4, Pentagonal specimens with a series of cells viewed from the front.
5, A worn specimen.
6, Dichotomously branched fragment with ovicelled zooecia corresponding to the description of Gabb and Horn for var. *capistratum*.
7, Encrusting ovicelled specimen with regenerated zooecia and different kinds of kenozooecia.
8, A zoarium encrusting *Coscinopleura digitata* and giving rise to erect branches. × 6.

FIGURE 9. *Mollia lacessitor*, new species (p. 37).
An entire colony (× 1 and × 20), encrusting a Serpula and showing the somewhat trifoliate opesium with straight proximal border.

10. *Mollia parvicella*, new species (p. 38).
The encrusting zoarium with ovicells and illustrating the small zooecial dimensions. From Noxontown Millpond, Del.

PLATE 8

FIGURE 1. *Monoporella* (?) *laticella*, new species (p. 39).
The encrusting zoarium showing the large wide zooecia and the two opesiules, as well as the olocystal frontal.

2, 3. *Diacanthopora convexa*, new species (p. 68).
2, Surface of the encrusting zoarium, showing the ancestrula.
3, Part of a zoarium, showing that the epicalcification is individual, much thickens the distal peristome, and hides the spines.

4. *Micropora parva*, new species (p. 35).
Portion of an encrusting zoarium. The linear opesiules, small zooecia, and triangular avicularium are shown. From Noxontown Millpond, Del.

5. *Micropora* (?) *pulchra* Ulrich and Bassler, 1907 (p. 36).
The type specimen, a free, narrow, bilamellar frond, showing the zooecia without opesiules but with a polypidianlike lamella and also the endozooecial ovicells.

6. *Micropora* (?) *cylindracea* Ulrich and Bassler, 1907 (p. 36).
The free cylindrical fragmentary type specimen.

7. *Rhagasostoma americana*, new species (p. 40).
Portion of the encrusting zoarium with ancestrula. The primoserial fusiform onychocellarium is apparent. From Noxontown Millpond, Del.

8. *Micropora ogivalina*, new species (p. 35).
Portion of the encrusting colony, illustrating the ogival form of zooecia and the short linear opesiules.

PLATE 9

FIGURES 1–6. *Coscinopleura digitata* Morton, 1834 (p. 42).
1, Surface of the narrow bilamellar zoarium with ordinary and ovicelled zooecia. From Noxontown Millpond, Del.
2, Fragment showing the marginal vibracular zooecia. From Noxontown Millpond, Del.
3, Bilamellar specimen, showing the lateral kenozooecia of reinforcement.
4, Vibracula arranged at the bifurcation.
5, An example (× 6) with zooecia transformed into kenozooecia reinforcing a bifurcation and the middle of the branch. The transformation of zooecia into kenozooecia is visible.
6, Specimen (× 10) showing a branch reinforced in the middle by zooecia transformed into kenozooecia.

7, 8. *Setosinella prolifica*, new species (p. 41).
Two portions of the same encrusting zoarium with ovicells and ancestrula. The zooecial characters, the hyperstomial ovicell, and the setiform avicularia are indicated.

Plate 10

Figures 1–3. *Acolopora grandis*, new species (p. 46).

1, Ovicelled example of the encrusting zoarium with the avicularia well shown.

2, A specimen showing the ancestrula as a small ordinary zooecium. From Blackwoodstown, N.J.

3, Marginal portion of a zoarium with ovicelled zooecia.

4, 5. *Distanseschar ella pumila* Gabb and Horn, 1862 (p. 47).

4, Surface of encrusting zoarium. The ancestrula is broken.

5, A specimen illustrating the very small zooecia and zooeciules and the hyperstomial ovicell.

6. *Lagynopora americana*, new species (p. 45).

Encrusting ovicelled specimen. The resemblance to *Membraniporella* is apparent. From Noxontown Millpond, Del.

7. *Distanseschar ella lata*, new species (p. 48).

Surface of the type specimen, an encrusting zoarium. The similarity to *D. pumila*, but with larger dimensions, is shown. From Noxontown Millpond, Del.

8. *Entalophora quadrangularis* Gabb and Horn, 1862.

The original illustration of some bryozoan that has not been identified in the recent studies. It may represent some worn Cheilostome like *Ochetosella jacksonica* Canu and Bassler of the Jacksonian and Vicksburgian.

Plate 11

Figures 1–5. *Pliophloea sagena* Morton, 1834 (p. 49).

1, Fragments of the free multilamellar zoarium. Natural size.

2, Surface of an exterior lamella illustrating the small zooecia.

3, Large zooecia of an interior lamella of a multilamellar zoarium.

4, Transverse section through a multilamellar zoarium. Lamella 2 was checked in its development and covered by lamella 3.

5, Transverse section of the same zoarium. The zooecia of each lamella are independent of those of the adjacent lamellae.

6–11. *Pliophloea ventricosa*, new species (p. 51).

6, Two multilamellar, cylindrical, hollow zoaria. Natural size.

7, Surface of an encrusting ovicelled specimen. There are some ordinary zooeciules, an epizooecial zooeciule, and some aborted zooecia.

8, Central portion of the small colony of figure 6. The pelmas are visible at the talon of the costules in the form of small tuberosities.

9, Portion of an exterior subcolony of the larger example of figure 6, showing the false ancestrula. The small tuberosities on the talon of the costules are the pelmas.

10, Portion of colony showing a group of inverted zooecia. The inferior and superior zooecia are arranged in the normal way.

11, Zooecia showing the formation of the secondary tissue (frontal epicalcification).

PLATE 12

FIGURE 1. *Rhiniopora parvirostrata*, new species (p. 54).
Encrusting ovicelled specimen, illustrating the very small avicularia. From Noxontown Millpond, Del.

2, 3. *Rhiniopora tubulosa*, new species (p. 53).
2, Ordinary zooecia of the encrusting zoarium.
3, Zoarium with ovicelled zooecia. The operculum closes the hyperstomial ovicell and the apertura.

4. *Kelestoma simplex*, new species (p. 55).
Encrusting ovicelled specimen exhibiting the furrows separating the zooecia, the very small ovicell, and the small oral avicularia.

5, 6. *Anornithopora (?) fragilis*, new species (p. 60).
5, Portion of the encrusting colony where some zooecia have preserved their costules.
6, Ovicelled portion of another colony. The operculum closes the ovicell. One of the ovicells is partly mutilated.

7. *Nannopora (?) minimora*, new species (p. 52).
View of the encrusting zoarium, showing resemblances to *Cribrilaria radiata*.

8. *Pliophloea elegans*, new species (p. 50).
Ovicelled portion of an encrusting zoarium. The vibracula are very small. From Noxontown Millpond, Del.

PLATE 13

FIGURES 1, 2. *Tricephalopora prolifera* Gabb and Horn, 1862 (p. 56).
1, Surface of the encrusting zoarium, showing ovicelled zooecia, the central elliptical costulated area, and the pseudospiramen.
2, A much calcified specimen. The costulated area is reduced, and the costules are little distinct. The nature of the ovicell and the structure of the oral arch are visible.

3, 4. *Tricephalopora acutirostris*, new species (p. 57).
Two views of the free unilamellar zoarium with ovicelled zooecia. The straight avicularia, arrangement of costules, pseudospiramen, and hyperstomial ovicell are illustrated.

5. *Tricephalopora incrassata*, new species (p. 58).
Ovicelled zooecia of the encrusting zoarium much calcified. The epicalcification almost entirely surrounds the frontal.

6, 7. *Stichocados compositus* Lang, 1916 (p. 62).
6, Zooecia with incomplete frontal and without peripores (after Lang, 1922). × 27.
7, The unilamellar zoarium with adult zooecia well preserved and with frontal peripores. From near Blackwoodstown, N.J.

8. *Stichocados mucronatus*, new species (p. 64).
Portion of the encrusting type specimen, with ovicelled zooecia and showing the ancestrula.

9. *Hesperopora occidentalis* Lang, 1916 (p. 61).
Zooecia of the unilamellar zoarium (after Lang, 1922). × 27. From near Blackwoodstown, N.J.

Plate 14

Figures 1–3. *Polycephalopora birostrata*, new species (p. 59).

1, The encrusting zoarium with small ovicelled zooecia.

2, Ancestrular portion of another example.

3, An ovicelled zoarium with large zooecia.

4–7. *Diacanthopora abbottii* Gabb and Horn, 1862 (p. 65).

4, Bilamellar specimen with irregular zooecia. The talon of each avicularium is not on the same zooecium as its beak. The epicalcification is individual.

5, Surface of ovicelled specimen. The number and width of the costules are variable. The distal pelmatidia is often replaced by a pelma.

6, Another specimen with irregular zooecia and more constant avicularia.

7, Surface of another example, showing structure of ovicells.

8, 9. *Diacanthopora distans* Gabb and Horn, 1862 (p. 67).

8, Zooecia showing the structure of the ovicell, which crowns the zooecium and adds to its length.

9, Surface of the encrusting colony with ovicelled zooecia. The epicalcification is interzooecial and surrounds also the ovicell.

Plate 15

Figure 1. *Hippaliosina aspera* Gabb and Horn, 1862 (p. 81).

Surface of the encrusting zoarium. The frontal pores are false tremopores.

2–7. *Psilosecos muralis* Gabb and Horn, 1862 (p. 83).

2, Portion of the bilamellar zoarium, slightly worn and with thick walls.

3, Young branch in which the frontal is little calcified.

4, A bifurcated branch with thick walls. The distal avicularium and the lyrule are buried under the thickness of the walls.

5, Worn specimen.

6, Three transverse sections; the zooecia are exactly opposite one another.

7, Longitudinal section. The zooecia are opposed. (a = apertura; av=oral avicularium; z=zooecium.)

8. *Kleidionella (?) trabeculifera*, new species (p. 86).

Surface of the bilamellar zoarium, showing the urceolate zooecia with the peristomies joined by trabeculae and the salient mucron.

9. *Flustrella cylindrica* Gabb and Horn, 1862.

The original illustration of some undetermined species from near Mullica Hill, N.J., but possibly referring to *Stamenocella oculata* Ulrich and Bassler, 1907.

Plate 16

Figures 1–7. *Acanthionella typica* Gabb and Horn, 1860 (p. 84).

1, Zoarium (× 6) encrusting *Coscinopleura digitata* and emitting three bilamellar branches.

2, Surface of bilamellar specimen much calcified. The pores of calcification and the formation of new avicularia derange the order of the primitive avicularia. From near Blackwoodstown, N.J.

3, Marginal zooecia of an encrusting colony. They are identical with the zooecia of bilamellar specimens.

4, Encrusting zoarium with its ancestrula, which is a small ordinary zooecium.

5, Bifurcated branch, showing the arrangement of the zooecia below the bifurcation. The epicalcification is little intense, and the ovicells are still visible exteriorly.

6, Bilamellar specimen, showing the progress of epicalcification (from top to bottom). The ovicell is hidden by the avicularia and is visible only by its orifice placed above the apertura.

7, Young ovicelled branch with regular and little calcified zooecia. The ovicells are large and salient.

Plate 17

Figure 1. *Dacryopora (?) orbifera*, new species (p. 71).

The uniserial encrusting type specimen. From Noxontown Millpond, Del.

2–5. *Exochella septentrionalis*, new species (p. 79).

2, The encrusting zoarium with ovicelled zooecia. The ancestrula is a small ordinary zooecium; the mucron is little salient.

3, Ancestrular portion of figure 4, showing a membraniporoid ancestrula surrounded by four avicularia.

4, A zoarium showing marginal ovicelled zooecia with 1 or 2 oral avicularia.

5, Ancestrular portion of another specimen. The ancestrula is membraniporoid with 4 spines and surrounded by 2 avicularia.

6, 7. *Diplotresis sparsiporosa* Ulrich and Bassler, 1907 (p. 72).

6, Surface of the encrusting zoarium with regular zooecia and containing series and groups of zooeciules.

7, Portion of a zoarium with irregular zooecia.

Plate 18

Figure 1. *Hippothoa tenuichorda* Ulrich and Bassler, 1907 (p. 71).

The encrusting zoarium of narrow, elongate, club-shaped zooecia.

2, 3. *Beisselina intermedia*, new species (p. 75).

2, Median part of the bifoliate zoarium, showing the arrangement of the large avicularia.

3, Several fragments (natural size) and lateral portion of a branch (× 20). There are 4 to 6 small peristomial avicularia and 3 to 5 small frontal avicularia.

4. *Beisselina lonsdalei*, new species (p. 77).

The type specimen, a bifurcated branch (natural size and × 20). Each peristomice is surrounded by 4 or 5 avicularia. The frontal is hidden by 4 to 8 small avicularia.

Plate 19

Figures 1–6. *Beisselina mortoni*, new species (p. 76).

1, Fragments of zoaria. Natural size.

2, Branch with a single avicularium on the proximal lip of the peristomice, forming the mucron. The ascopore is small.

3, Specimen slightly worn. The proximal avicularium is in its place, but there is no avicularian mucron.

4, Portion of a branch with a large avicularium.

5, Branch somewhat worn. The peristomes bear on their proximal lip 2 or 3 avicularia, replacing the avicularian mucron.

6, Worn specimen.

7–13. *Beisselina labiata* Gabb and Horn, 1862 (p. 73).

7, Fragments. Natural size.

8, A colony (× 3) showing the base grasping another bryozoan.

9, Surface of a branch in which the zooecia have very large ascopores.

10, A bifurcated branch with small ascopores. The frontal of each zooecium is covered by three small avicularia or by a single very large one.

11, Edge of a branch. The ascopores are very large.

12, Longitudinal section in a branch having large frontal avicularia.

13, Transverse sections. (a=apertura; as=ascopore; av= small frontal avicularia; Av=large frontal avicularia; pe= peristomice (external aperture); pi=peristomie; z= zooecium.)

Plate 20

Figures 1–3. *Perigastrella exserta* Gabb and Horn, 1862 (p. 80).

1, Surface of the encrusting zoarium with some zooecia so worn as to show the dietellae.

2, Zooecia illustrating the fringed peristome and the recumbent ovicell.

3, A specimen in which the distal dietellae are visible on the broken zooecia and the areolar pores are apparent.

4–7. *Monoporella* (?) *vincentownensis* Ulrich and Bassler, 1907 (p. 39).

4, A small colony with opesiules visible. From near Blackwoodstown, N.J.

5, Portion of the encrusting zoarium with one complete and one broken ovicell. From near Blackwoodstown, N.J.

6, Surface of zoarium with lamellar expansions marking the place of ancient ovicells or those not fully formed.

7, A typical expansion with ovicells and opesiular indentations visible. From near Blackwoodstown, N.J.

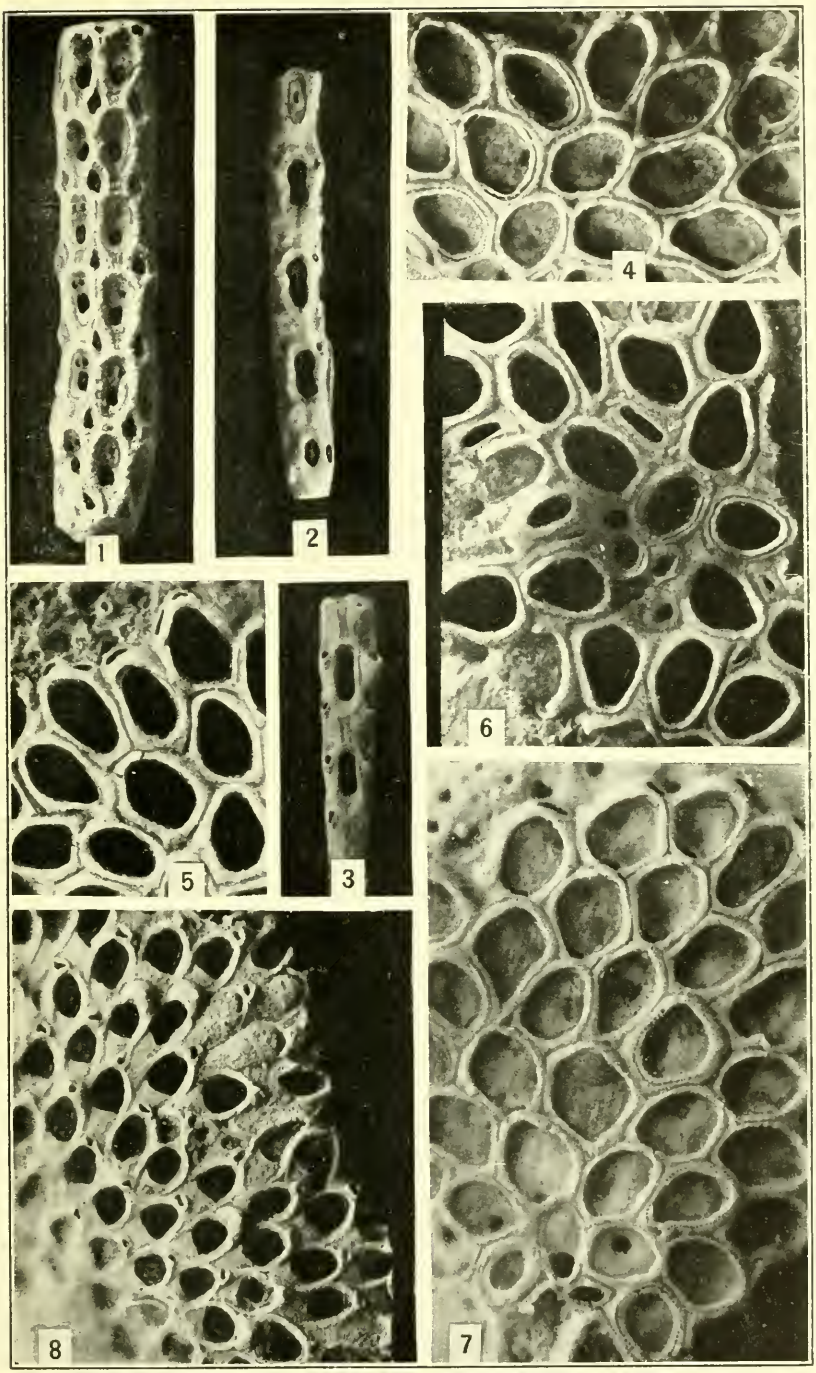
8. *Diacanthopora marginata* Gabb and Horn, 1862 (p. 69).

The original illustration of this encrusting species, which has not been rediscovered. From Mullica Hill, N.J.

PLATE 21

Upper: Surface of an indurated layer of fossiliferous limesand, natural size, from the marl pit at Vincentown, N.J., shown in the illustration below. The flat side of a few examples of the ribbonlike branches of *Coscinopleura digitata* Morton and the irregular fronds of *Pliophloca sagena* Morton are visible, but most of the many bryozoan fragments present are very small or are placed edgewise.

Lower: Marl pit at Vincentown, N.J., which has supplied a large part of the Bryozoa studied by the authors. The undulating line marks the unconformity of the Vincentown limesand formation below and the overlying strata of more recent age. The limesand is unusually fossiliferous at this point, and sifting of the loose sand resulted in many millions of fragmentary Bryozoa. Certain beds have been cemented together producing layers of harder rock, as shown in the upper figure.



VINCENTOWN LIMESAND BRYOZOA.

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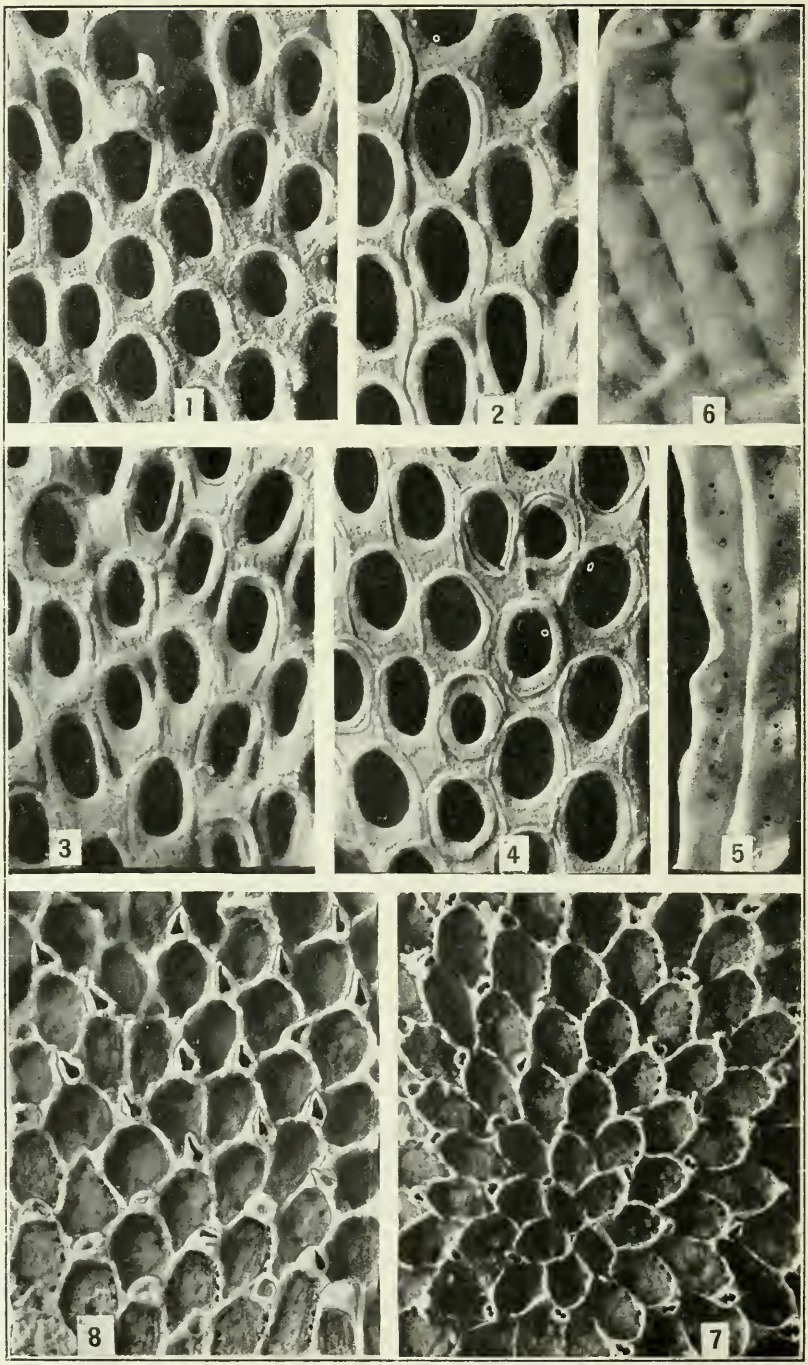

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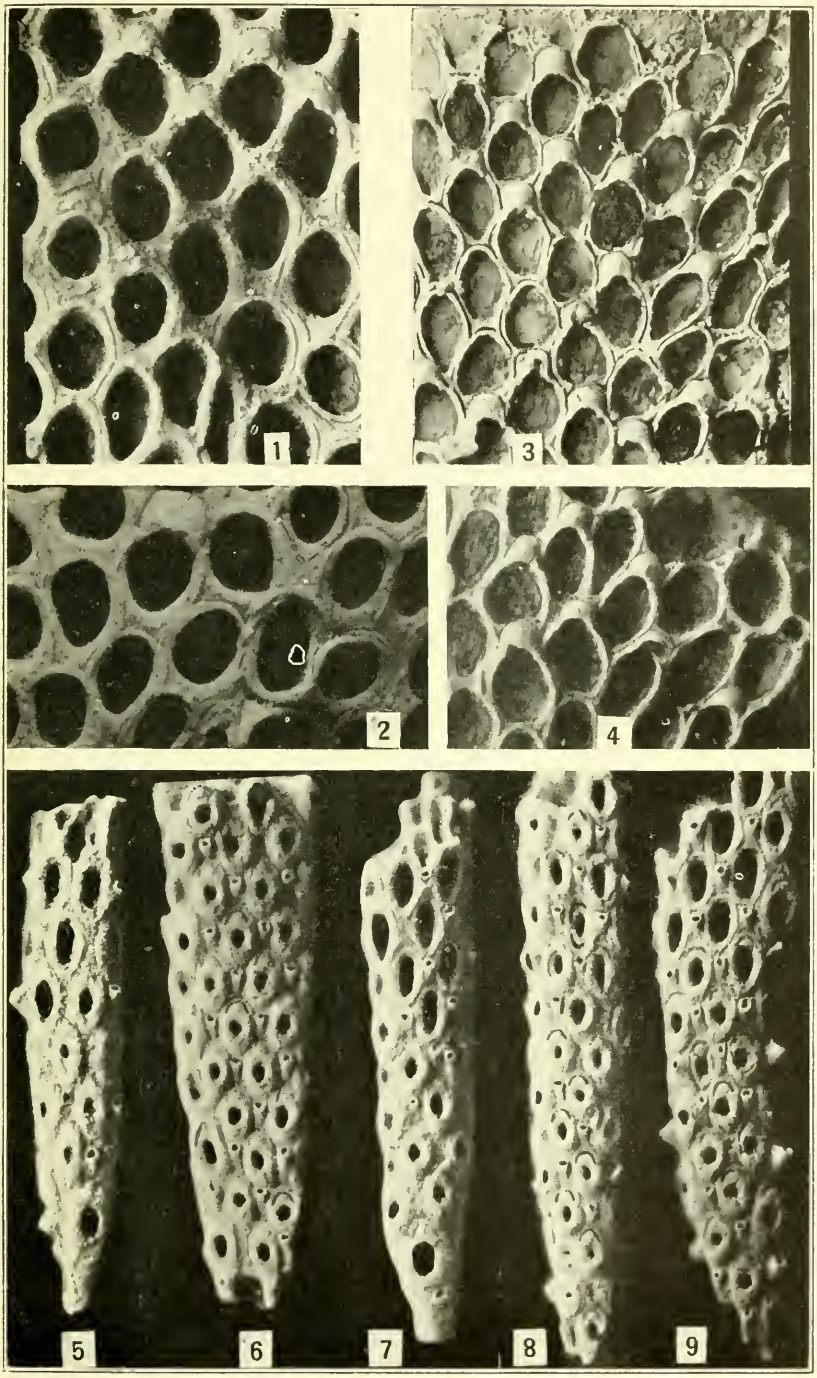

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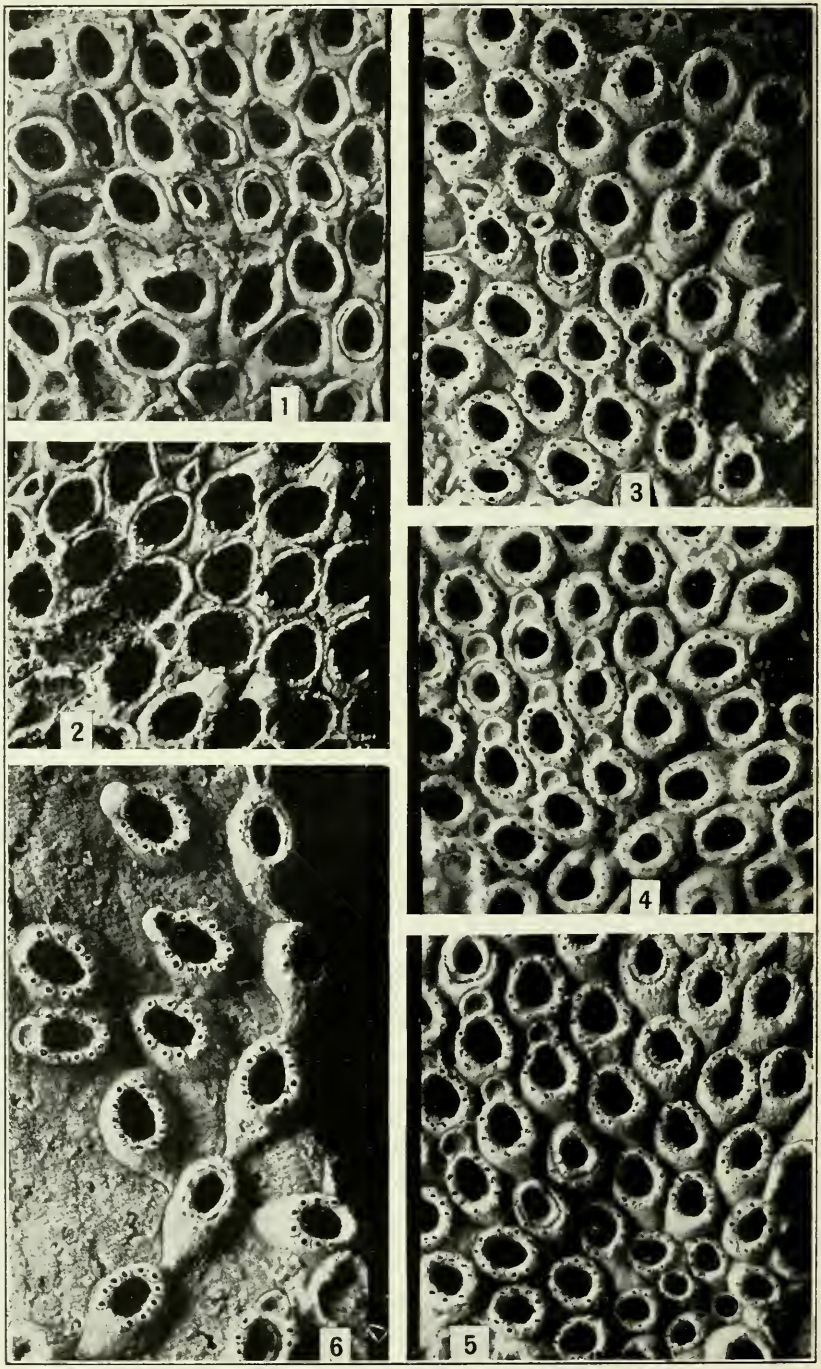

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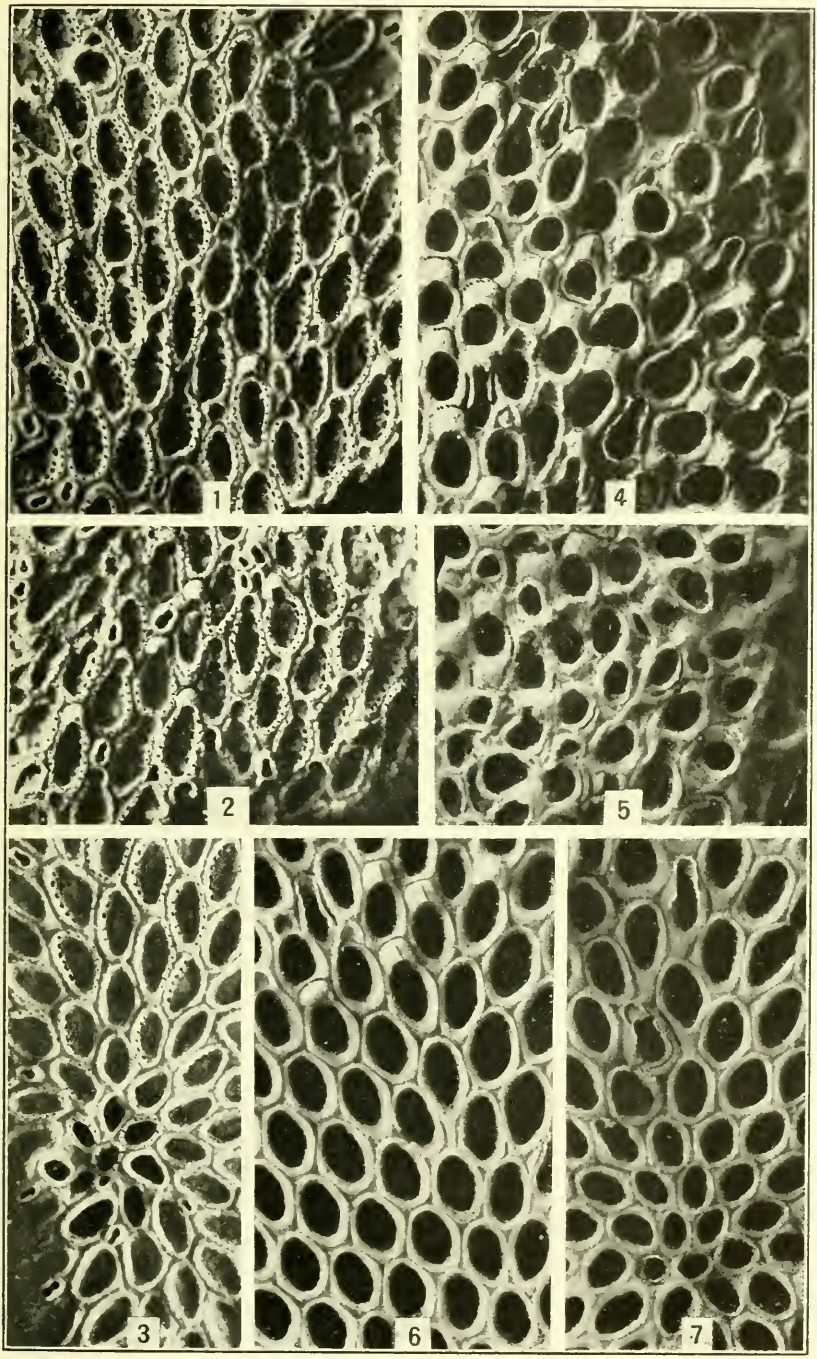

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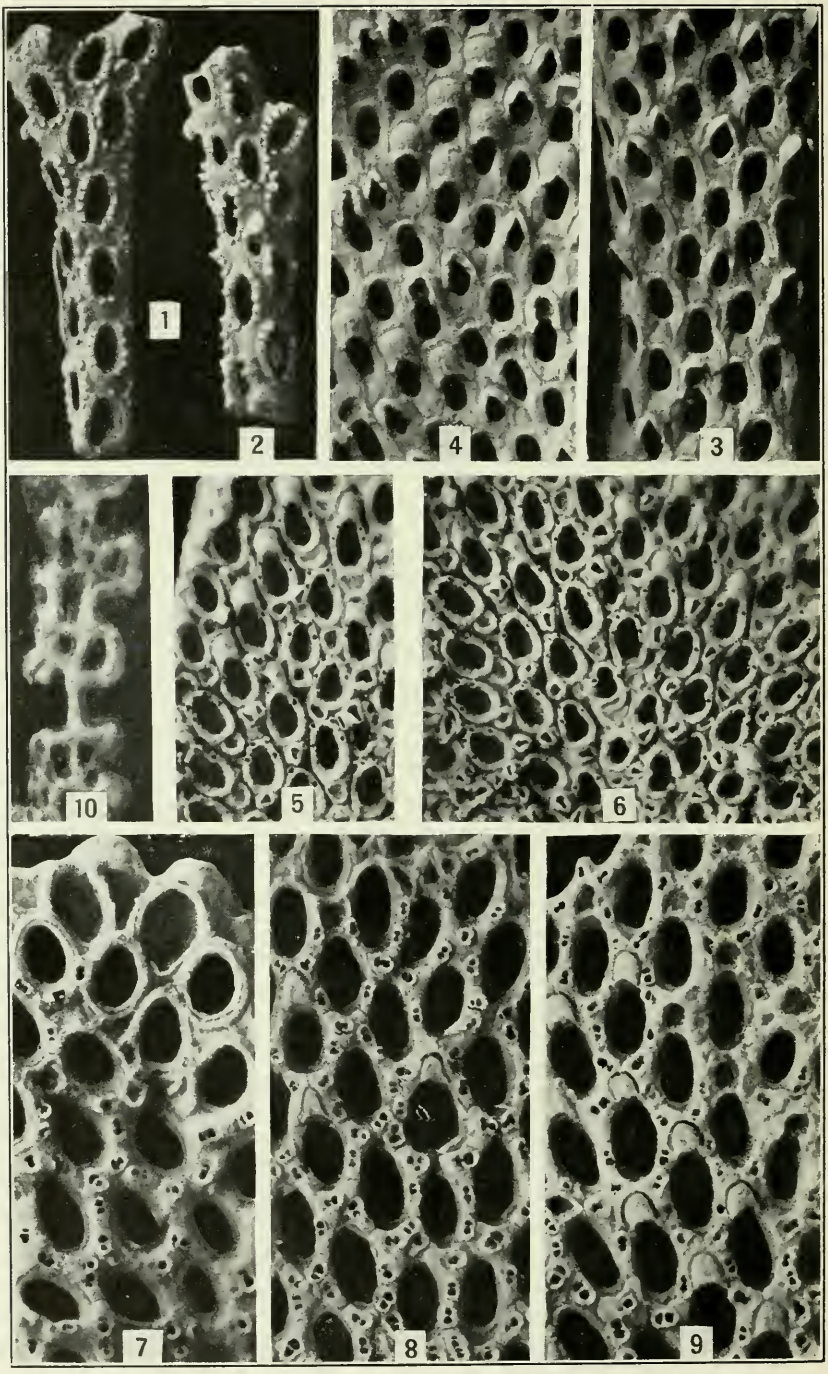

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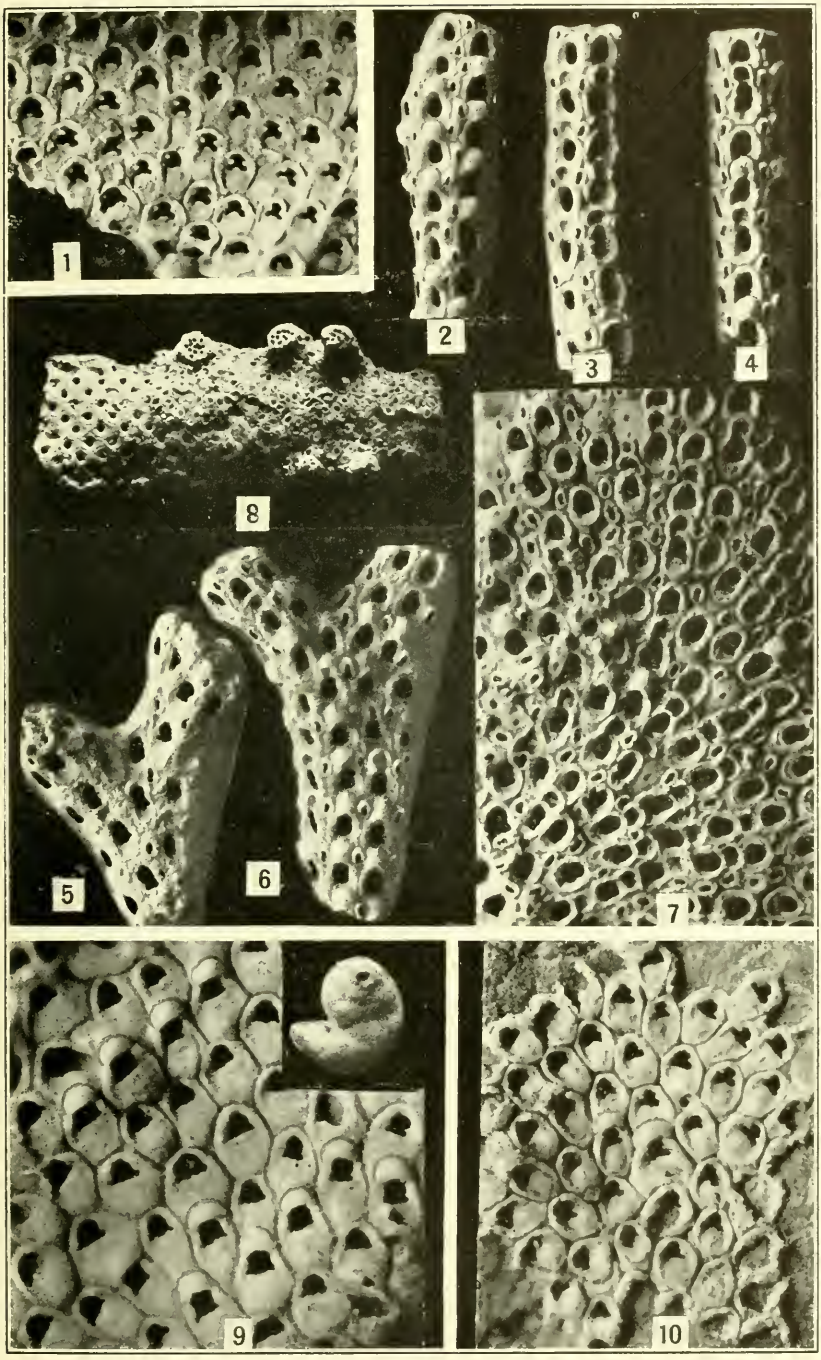

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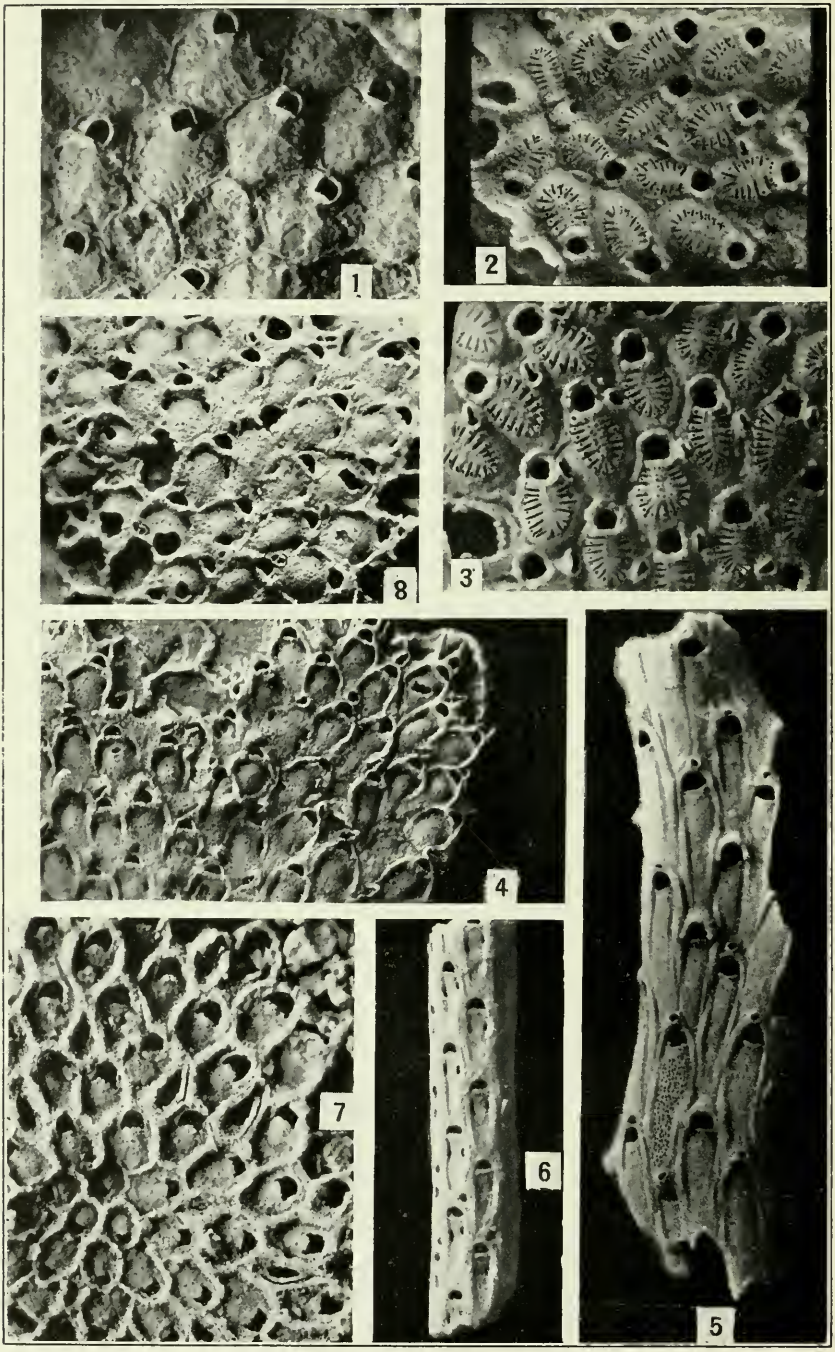

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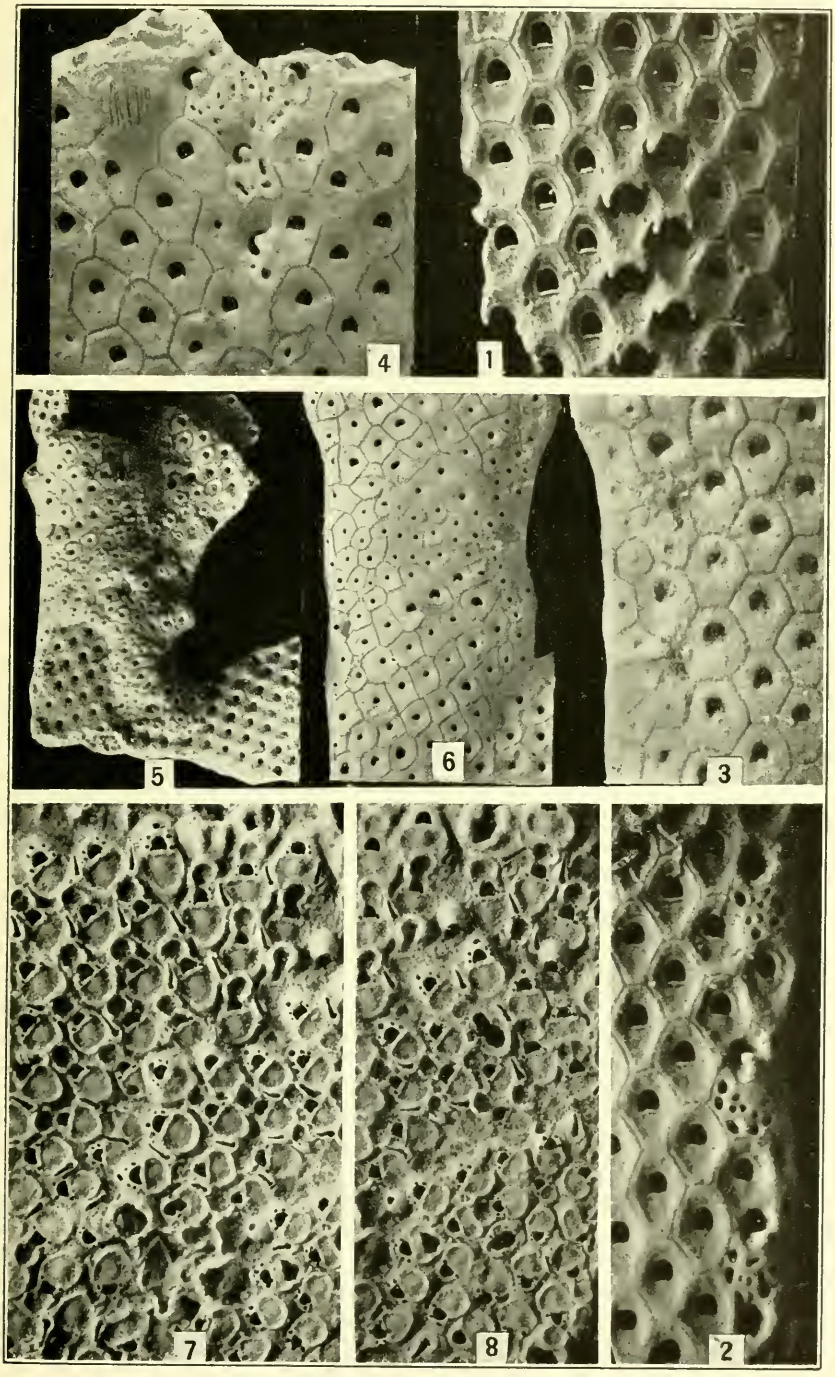

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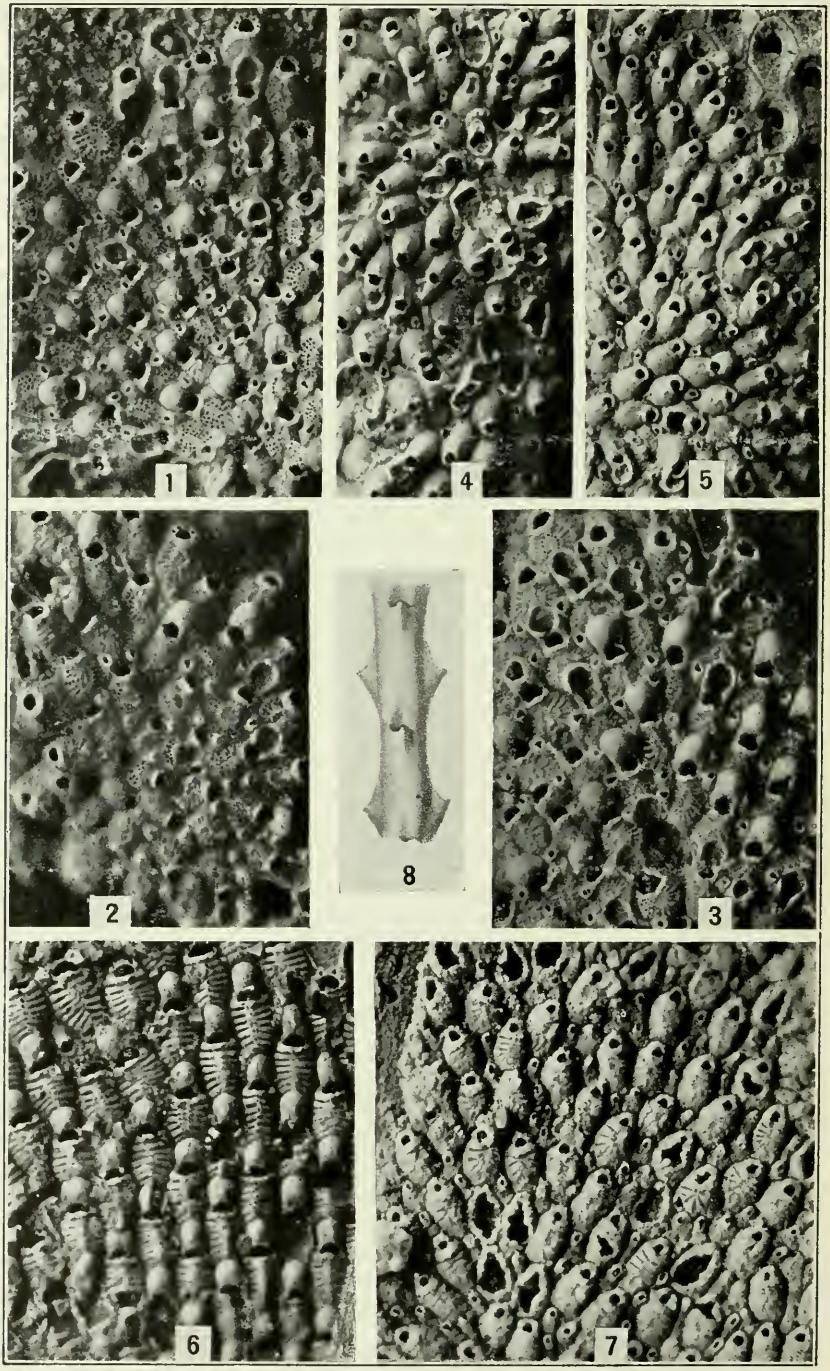

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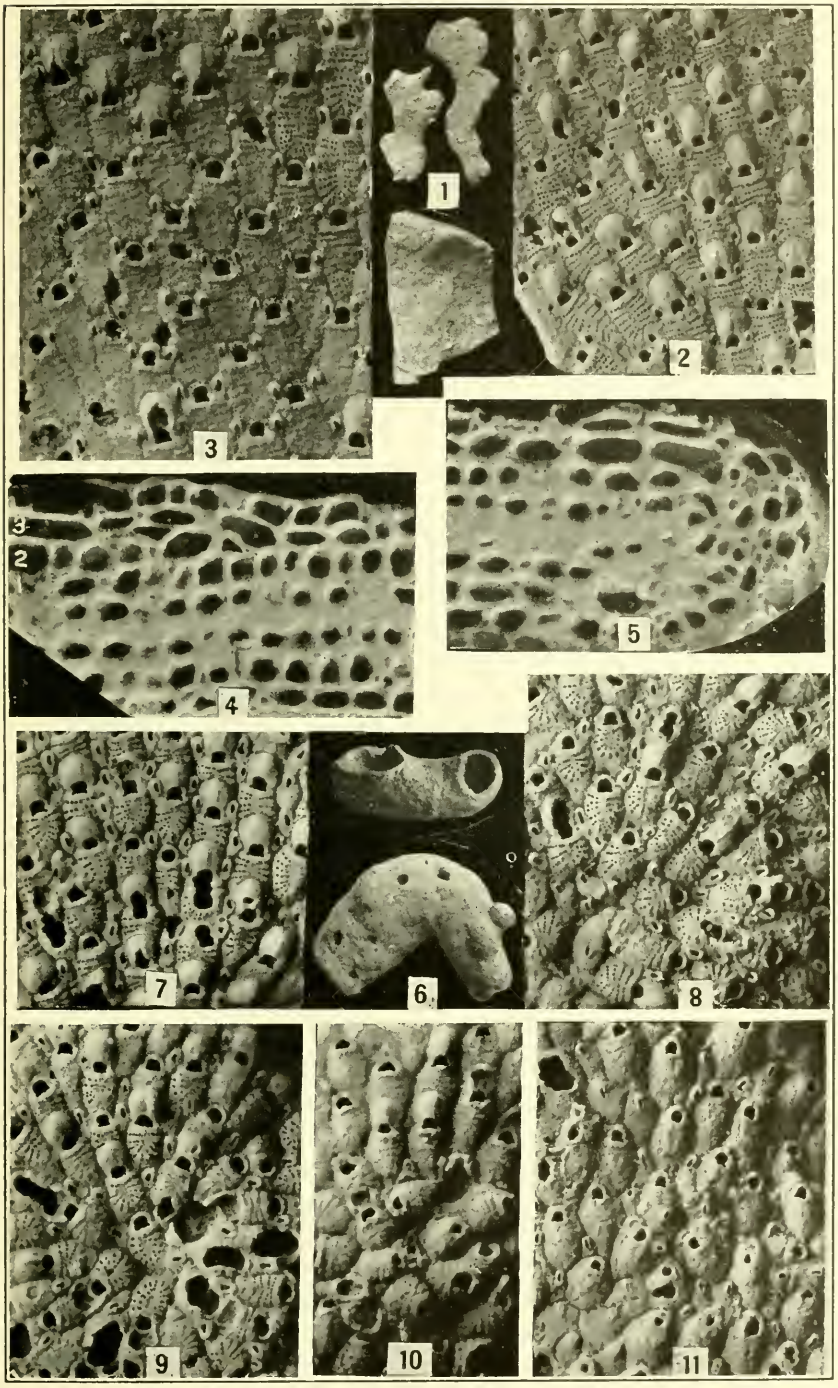

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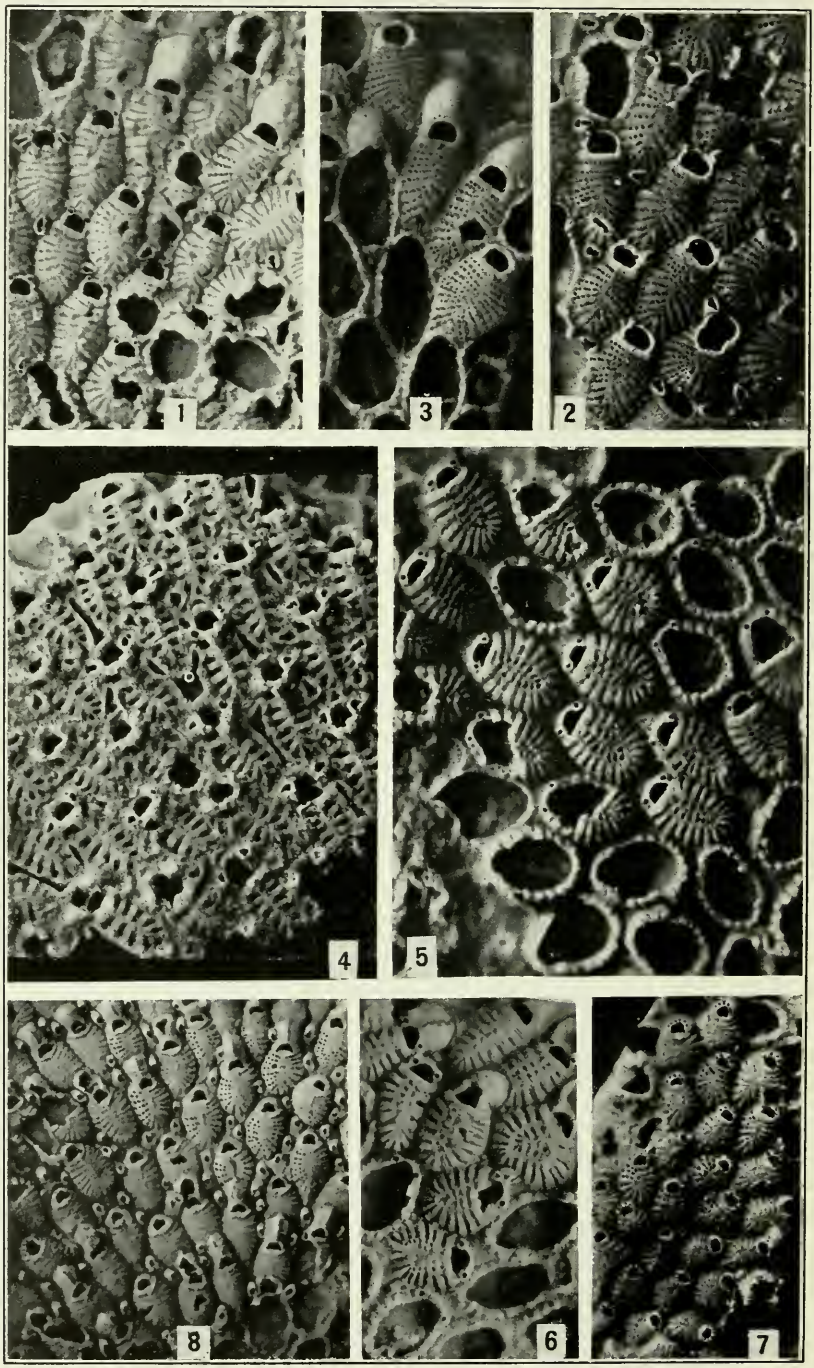

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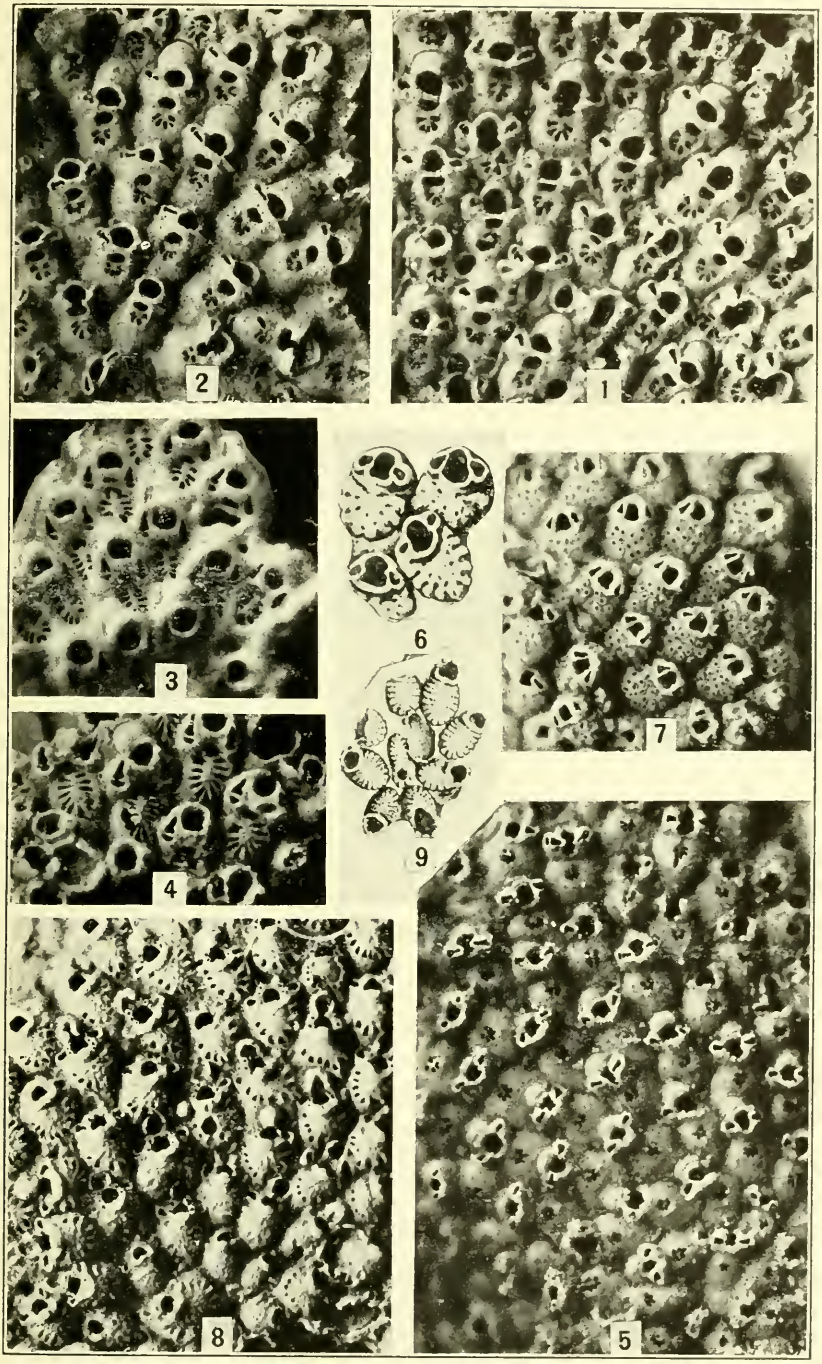

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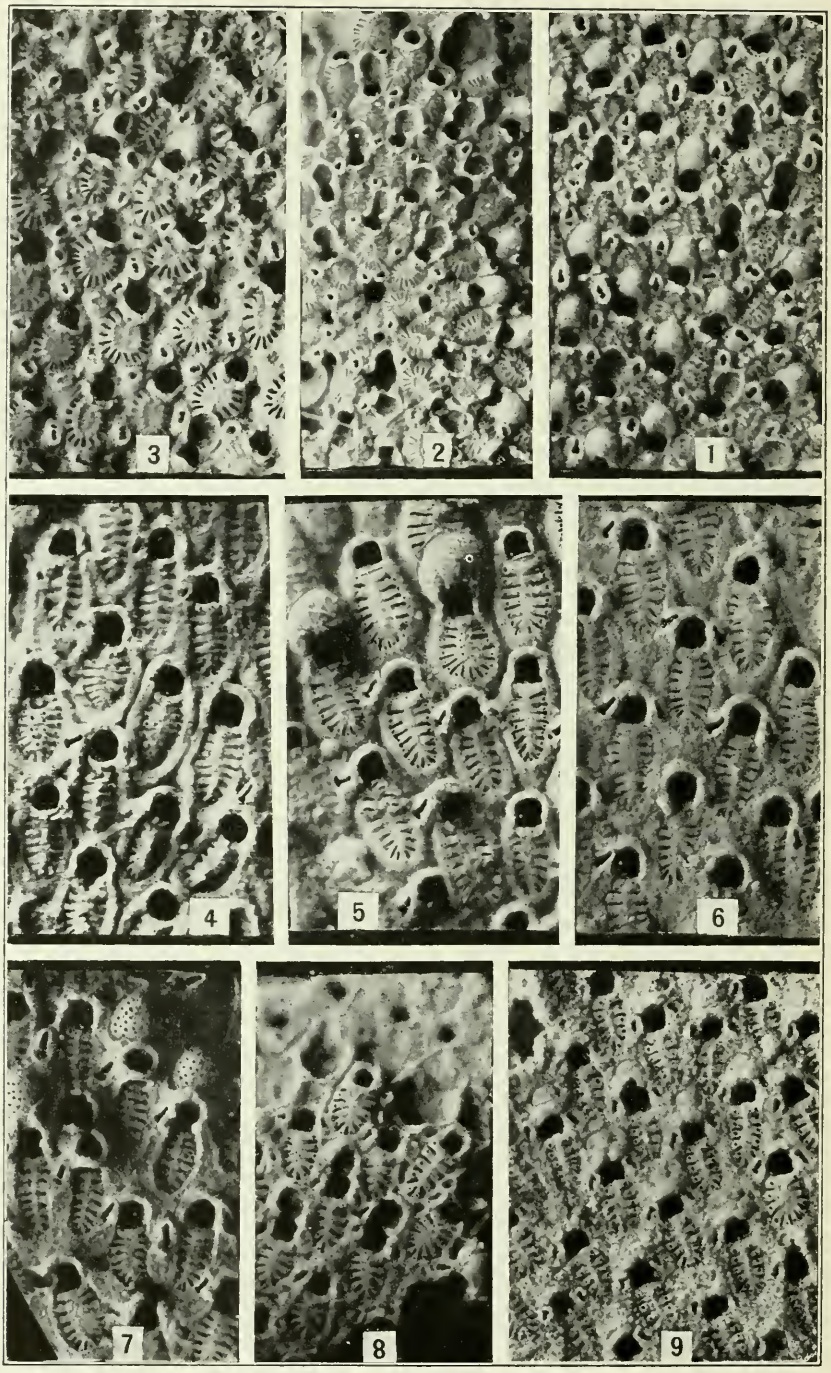

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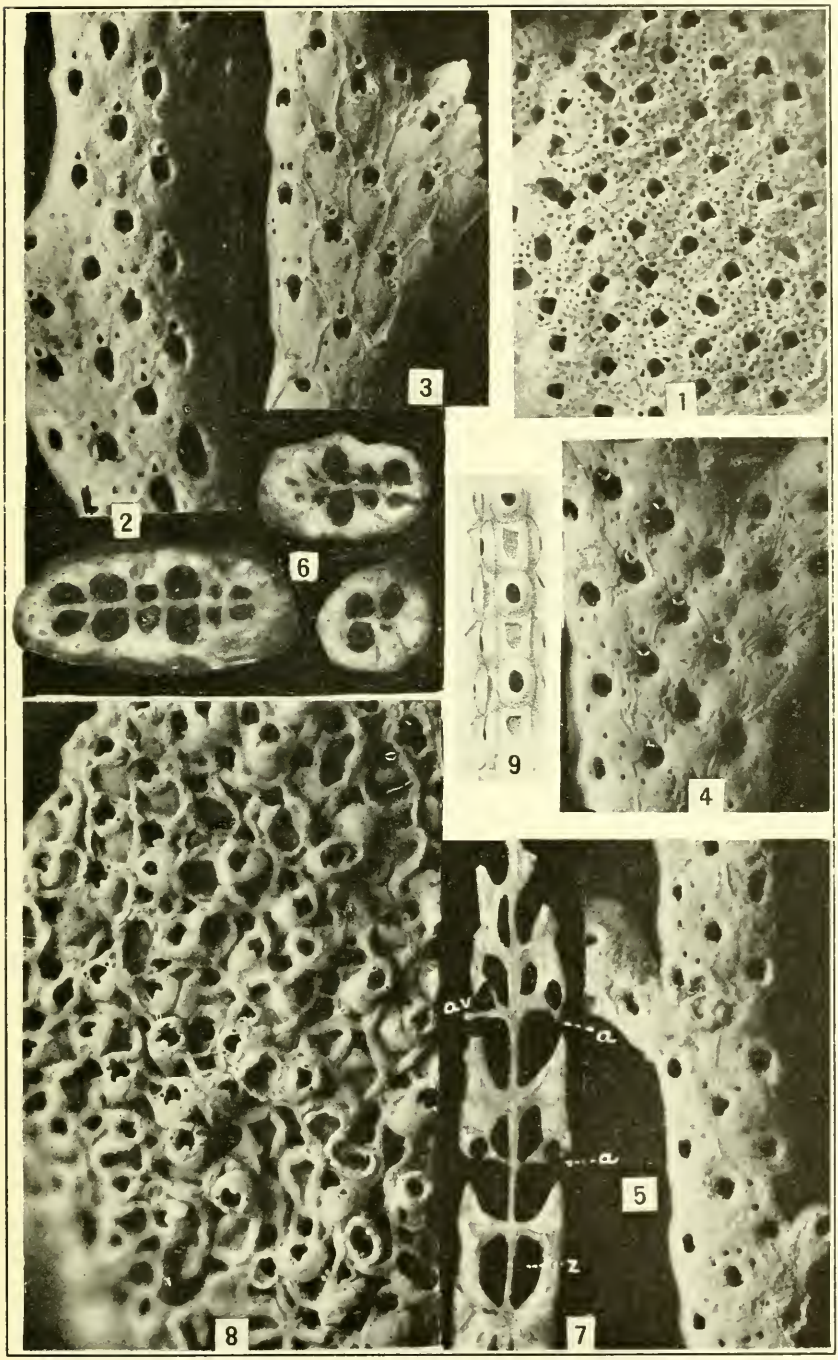

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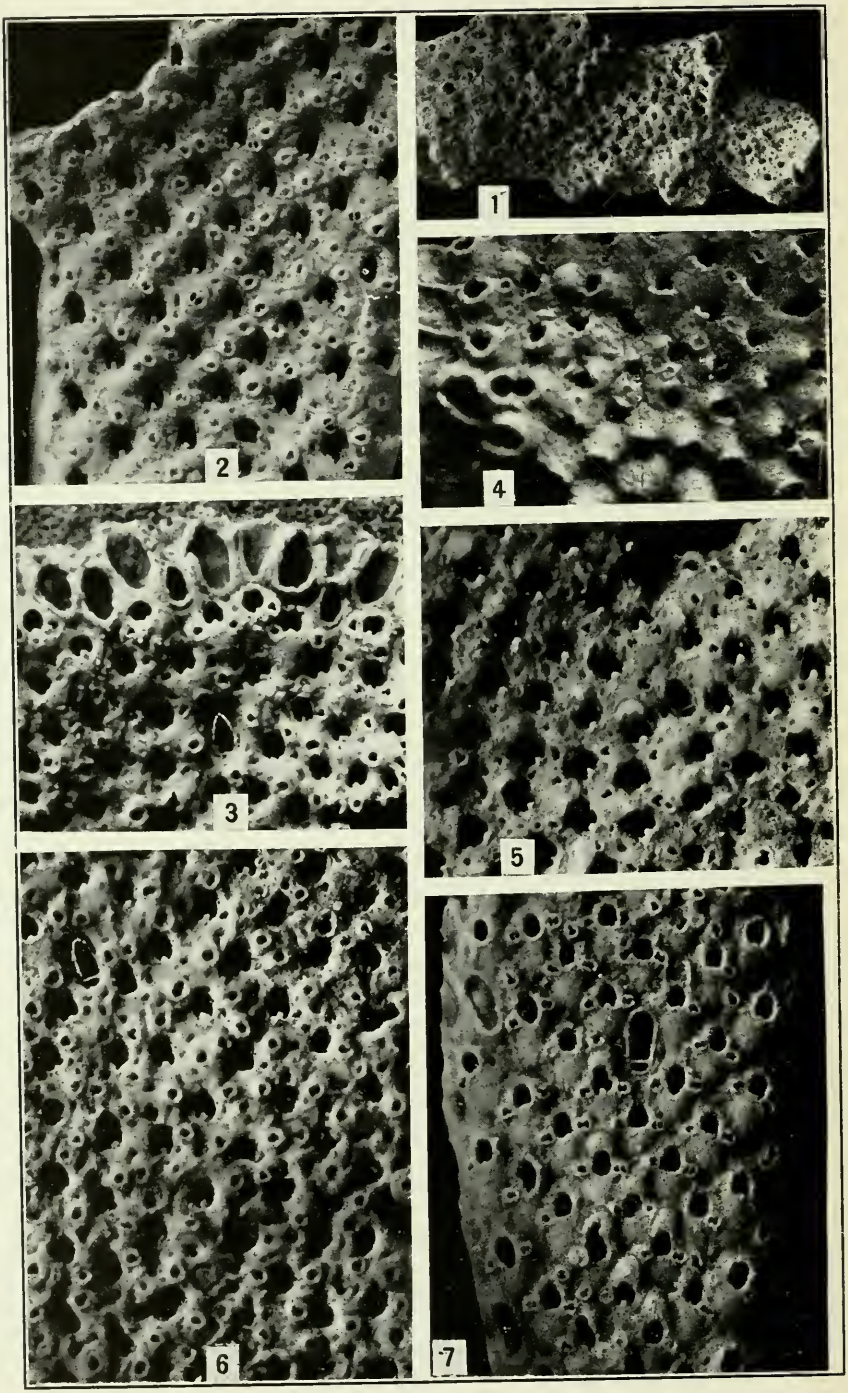

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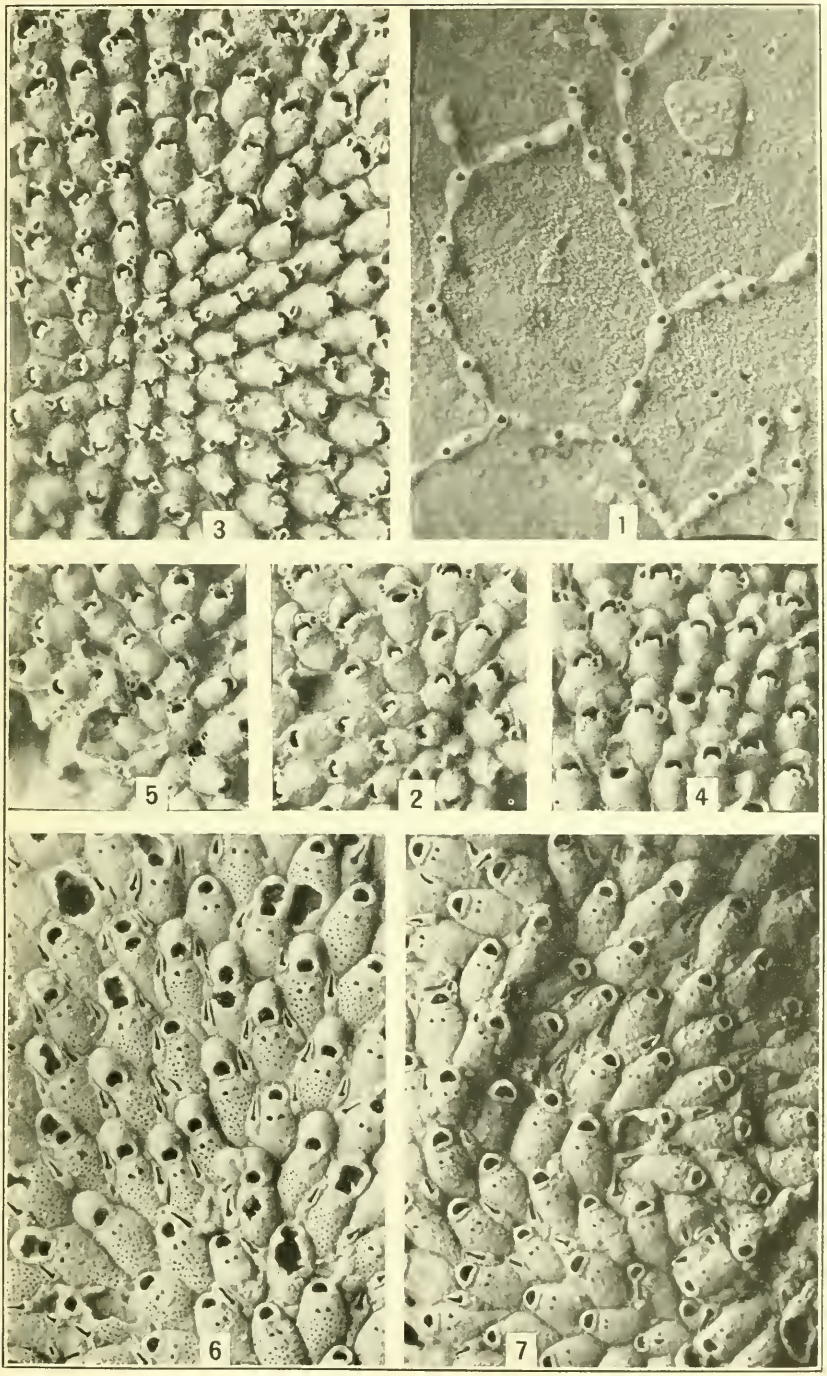

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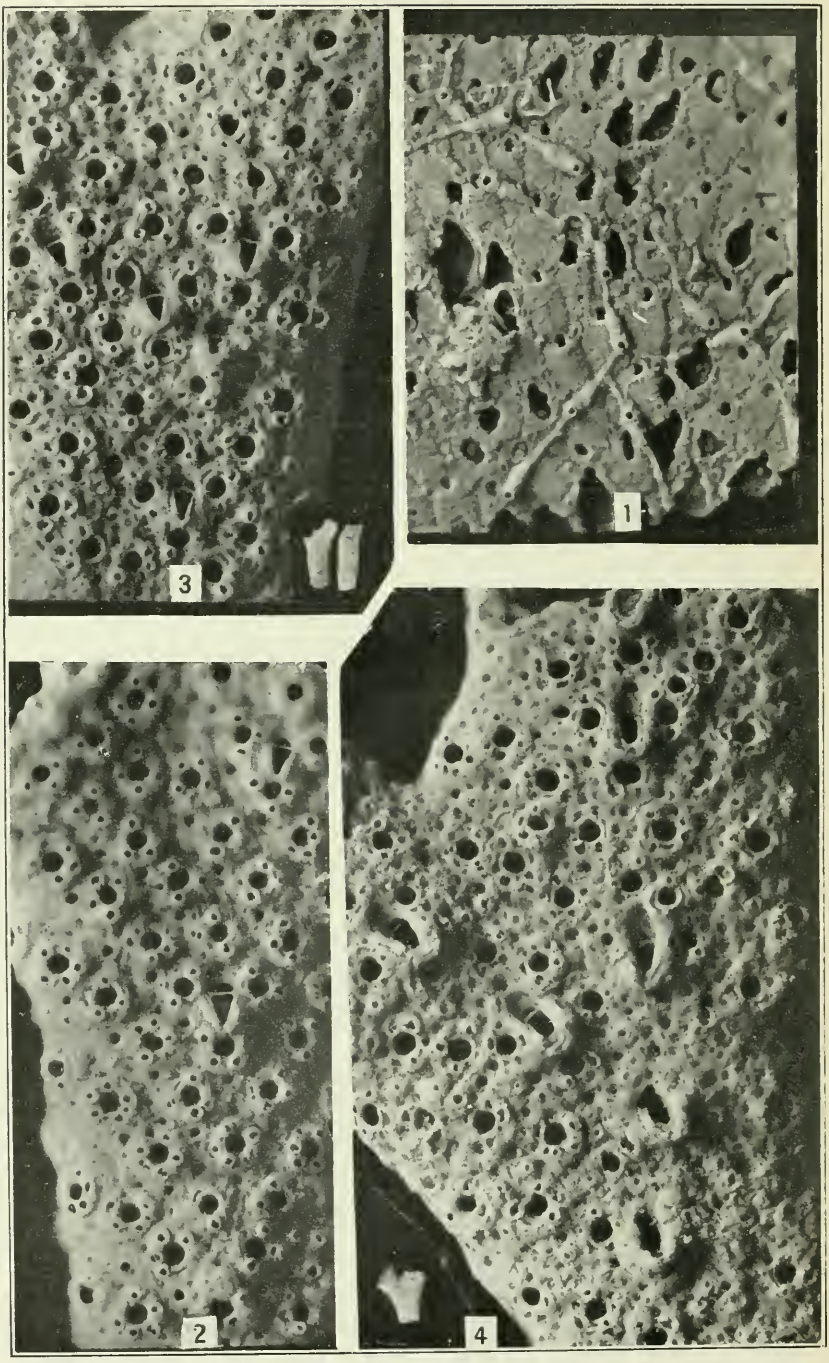

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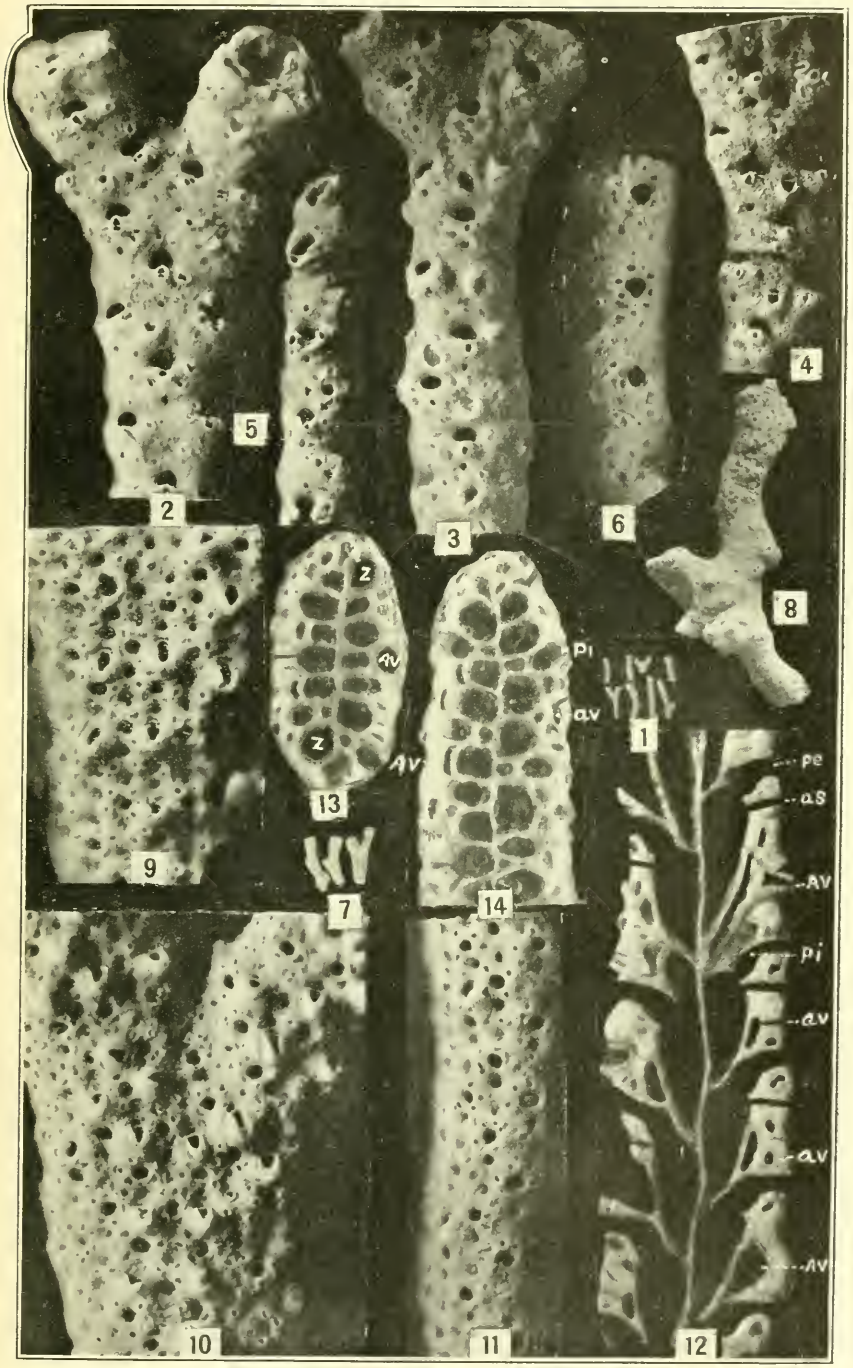

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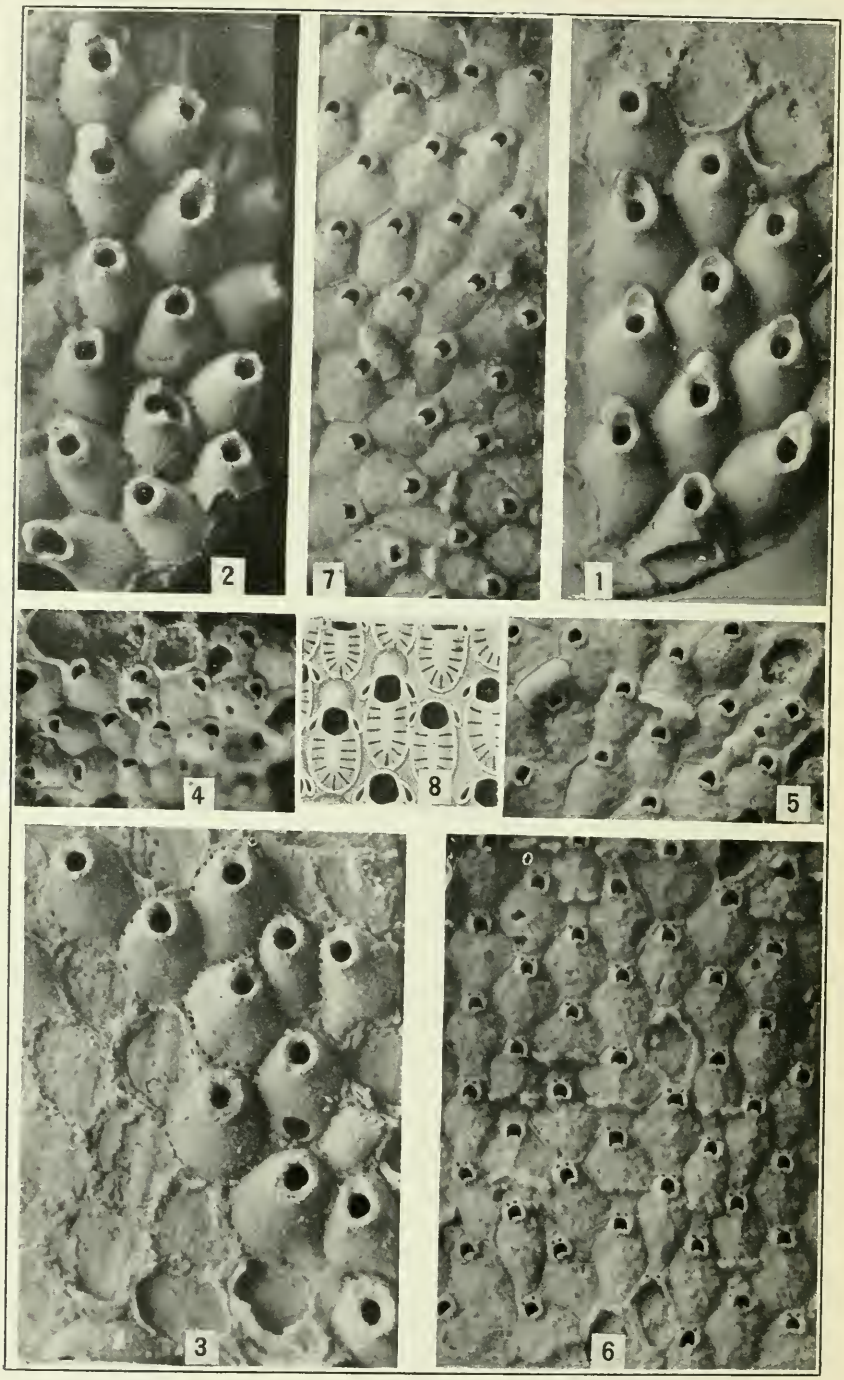

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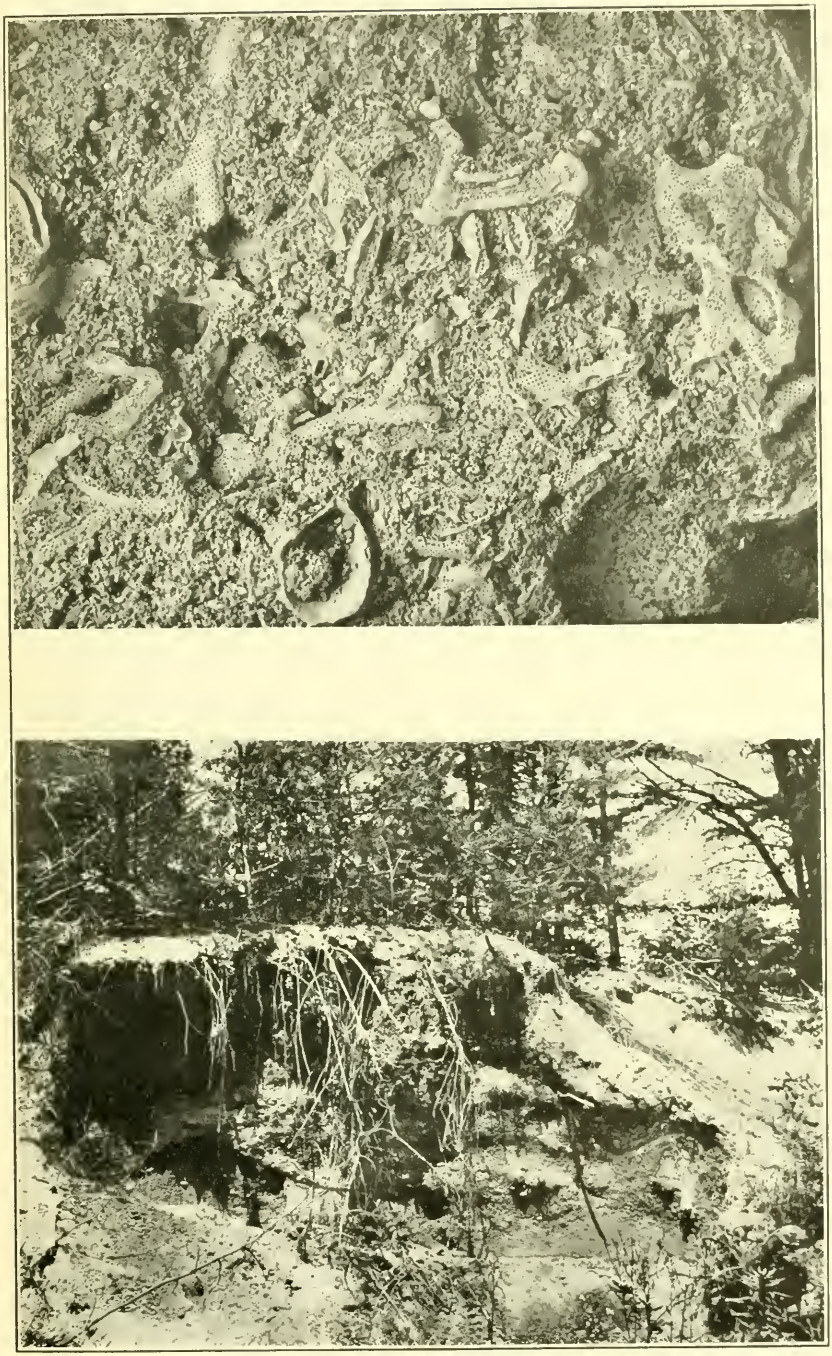

MARL PIT AT VINCENTOWN, N.J., AND FOSSILIFEROUS LIMESAND THEREFROM.

FOR EXPLANATION OF PLATE SEE PAGE 102.

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